Vol. LXXXIV DECEMBER, 1926 No. 6

ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

Edited by
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of New York
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ANNALS of SURGERY

VOL. LXXXIV DECEMBER, 1926 No. 6

ISCHÆMIC CONTRACTURE*

EXPERIMENTAL STUDY

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DEFINITION.—Ischæmic contracture is a specific deformity following an injury to the extremities, and usually occurs in children between three and twelve years of age, whose blood-vessels are less mature and more easily disturbed than those of older persons. In the majority of cases the injury is in the upper extremity, at or near the elbow-joint. As it usually comes on following a fall or a blow in cases of fracture, and at times when there has been no fracture, there is an extensive injury to the soft parts in the fold of the joint with a resulting hæmatoma. Usually fixation by one or another method or tight bandaging has been applied, causing severe pressure on the structures in the region involved, and in a short time swelling and blueness of the extremity with paræsthesia followed by more or less pain. Within a varying period after these symptoms, and even after the removal of the fixation or bandage, there is swelling in the muscles, especially the flexors. These muscles gradually shorten, and there follows a severe contraction of the wrist as well as of the fingers, and in the more advanced stage, the claw-hand deformity results. In some cases there is limitation of supination and pronation. The joints are usually not affected. The fingers can be extended if the wrist is hyperflexed. The muscles are hard and rope-like, and often there is a slough on the flexor surface of the arm. Even the skin may have a hard leathery feeling. There may be disturbances in sensation in areas supplied by one or more nerves, most frequently only in this part of the hand supplied by the ulnar nerve, but sometimes in the area supplied by the median or radial nerves.

Following these usual initial symptoms the fingers become pale, cyanosed, and cold. Within a few hours the patient complains that the fingers are numb. He is usually more concerned than the surgeon. Electric irritability of the muscle is lost after about five hours of ischæmia, in some cases in as short a time as three and one-half hours. The muscles become flaccid and powerless. Muscular rigidity is then noted and the painful contracture begins. This disappears in about sixty-five to seventy hours, leaving the muscles again flaccid and very tender to pressure. After a few more days the

* Submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Orthopædic Surgery, April, 1926.

swelling disappears and muscular tissue begins to be replaced by fibrous tissue. Muscles then become hard and resistant, and muscular atrophy appears.

The tension on the extensor musculature of the fingers as a result of the hypertension in the metacarpophalangeal joints is practically unavoidable even though extensor muscles are usually not involved in myositic changes.

A gross pathologic study of the condition shows that the muscular tissue is pale yellow, hard and board-like, and that the tendons are usually matted together. As a rule there is no change in the joints other than a tendency toward subluxation. The nerves appear to be flattened. Microscopically there is a loss of muscle striations, atrophy of the muscle fibres, a loss of the nuclei of the muscle fibres, and an increase in connective tissue.

Review of the Literature.—In 1869, and later in 1875, Volkmann described a deformity of the hand and wrist resulting from an interference of some nature with the blood supply of the muscles of the forearm. This condition was usually preceded by the application of splints or bandages for fracture of the humerus in the region of the elbow-joint. In his classical article published in 1881, Volkmann said that he believed the affection was due to ischæmia caused by the muscular tissue being deprived of arterial blood, in consequence of which the muscle perished from want of oxygen. He called attention to the fact that the contracture comes on sometime after the initial paralysis; that it becomes more marked as more repair tissue is laid down; and that from the onset of the condition there is considerable rigidity which is increased as more scar tissue is formed. He reported but one case in 1875 and that was in a child of sixteen. Mention of this case was made in his book published in 1869. Previous to this Hildebrand, in 1850, quoted a case of Hamilton's without giving the reference, but so far Hamilton's account has not been found.

The credit of calling attention to the condition and establishing it as a real entity belongs to Leser. In 1884 he reported seven cases. A little later he investigated the condition experimentally, using dogs in his research work. He gave a comprehensive and detailed account of the findings. Leser believed the condition was caused by a deprivation of oxygen to the muscles, but gave no definite theory as to how this lack of oxygen was caused.

Bardenheuer maintained that the pathologic change was due to a vascular disturbance such as venous stasis, and that the degeneration of the muscle fibres was caused by the retention of toxic metabolic products in the muscle. Rowlands believed that the paralysis and contracture were the result of the sudden release of pressure on the muscles, allowing the blood to congest the muscular tissue. Murphy believed that the condition was due to a pressure ischæmic myositis caused by hemorrhage and effusion into the muscles. This condition is augmented by the constriction of a splint or bandage or even by tight skin, and this in turn leads to myositis from pressure anæmia and later to contraction of muscles as a whole, resulting in a shortening of muscle tendon. He thought it was not injury to arteries but injury to veins that caused the destruction of the protoplasm of the muscle cells

Some of the cases reported by Langer and Schloffer were evidently due to embolism. Bardenheuer reported a case of fracture of the clavicle resulting in an ischæmic contracture brought about by bandaging the arm tightly to the body. Barnard, Dudgeon, and Ward reported cases in which contusion of the forearm without fracture resulted in contracture of the hand and fingers. Powers and Riedinger reported deformity following the use of elastic bandages.

Thomas contended that a mere circulatory disturbance was not sufficient in itself to cause a typical Volkmann's contracture.

FIG. 1.—Almost complete occlusion of blood-vessels resulting from operation as revealed by injection of suspension of barium sulphate.

Thomas, Bernhardt, Köbner, and von Frey, and others believed that the paralysis following the use of the elastic bandage resulted in a flaccid paralysis with no contracture in the paralyzed muscles due to an injury to the nerves at the time of the accident, or subsequently. He was preceded in his ideas by Petersen, who, in 1888, wrote of the occlusion of the arteries and the involvement of the nerves. Wallis and Brehmann reported cases in which nerves were involved. As far back as 1850, Hamilton found the median nerve stretched over a fragment of bone and obtained improvement following the release of tension. Thomas stated that the reaction of degeneration in the small muscles of the hand was positive evidence of involvement of the nerve trunks, because with a destructive inflammatory process in the muscle itself there would be only a diminished reaction, if any. Paralysis of the muscles of the hand can be due only to involvement of nerves.

Steindler placed the location of the injury at the epiphysis of the humerus, and corroborated this statement by citing a number of cases.

Some cases have been reported with limitation of supination or pronation, and one case with involvement of the pronator quadratus only, in which the contracture of this muscle limited supination. After this muscle was explored and sectioned to relieve the tension almost complete recovery followed.

Soubeyran has explained the exclusive localization of the contracture in the flexor and pronator muscles by the anatomy of the arterial system in the arm. When there has been an injury to the arm or forearm in the region of the elbow the circulation usually stops in the ventral part but persists in the dorsal area, owing to the anastomotic plexus of blood-vessels about the elbow. The defective circulation prevents the supply of oxygen from going to the flexor and pronator muscles. Certain transformations occur which are followed by shortening and stiffening of muscular fibrils.

FIG. 2.—Patency of blood-vessels in control extremity of same animal as in Fig. 1, as revealed by injection of suspension of barium sulphate.

Brooks showed in his experiments that total paralysis of the muscle could not occur. In some of his experiments he demonstrated totally viable and totally necrotic muscles adjacent to each other when there was arterial obstruction, but he did not believe such a condition was due to permanent arterial obstruction. He also showed that skin was more susceptible to a continued diminished blood supply than muscles, but muscles would survive for a shorter period than skin in complete absence of blood.

Davies-Colley found both the median and ulnar nerves small and purplish below the scar tissue in one case, and many others have reported similar conditions. Bradley has recently contributed the thought that atrophic changes are brought about by chemical liquefaction of the tissue proteins acted on by enzymes. Peptoids and amino-acids are formed as end products. In some cases of atrophy, digestion of the tissue proteins is further facilitated by phagocytosis, but this, of course, is a secondary process. Bradley believed that the increase of connective and adipose tissue in atrophied muscle was a compensatory invasive process from the intermuscular septum and a phenomenon secondary to the atrophy of the muscle itself.

Some writers (Davies-Colley) have maintained that the contracture is due to the scar tissue resulting from pressure sores, but this is disproved by those cases in which the typical deformity of the Volkmann-Leser contraction developed without pressure sores.

So far as I have been able to determine the mechanism of an ischæmic contracture as seen in man has never before been reproduced in an animal for the purpose of determining, if possible, a means of preventing this deformity. For this reason it was thought worth while to report the experiments begun in 1924 at the Institute of Experimental Medicine of The Mayo Foundation.

Method of Experimentation.—Dogs weighing approximately 12 kg. were used in all the experiments. Ether was used for the anæsthetic and all operative procedures were carried out with sterile technic. The non-operative procedures were carried out with due regard to the comfort of the animal and morphin was freely used.

In the first series of experiments an attempt was made to produce a more or less typical contracture deformity by means of splints, casts, and bandages, but it was soon seen that it was impossible to produce a deformity lasting for any length of time by these methods.

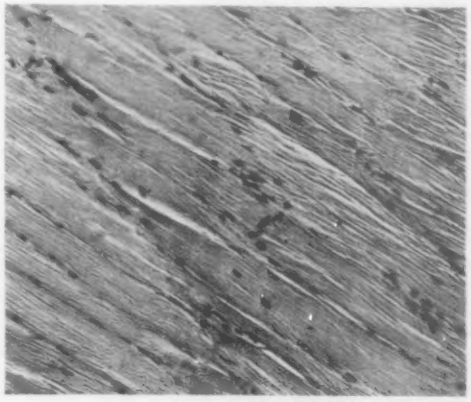

FIG. 3.—Longitudinal section of muscular tissue from ischæmic extremity of dog H90 (hæmatoxylin and eosin, × 120).

In the second series of experiments an Esmarch rubber bandage was applied above the knee of the right pelvic limb and left on for from one and one-half to twenty-four hours. In the animals who wore the rubber bandage for from one and one-half to three and one-half hours, the deformity manifested by a main-en-griffe, disappeared within three or four hours after removal of the tourniquet. In those with the bandage applied for a longer period the deformity remained for three or more days, but at the end of this time there was normal function in the extremity.

In the next series the dogs were operated on in pairs. In one animal a simple ligation of the femoral vein was performed through a longitudinal incision over the vein on the right thigh. The vein was isolated and ligated with linen as it lay in Hunter's canal. In the second animal in this series an incision was made on the medial side of the right thigh running parallel to, and about 6 cm. below, Poupart's ligament, in such a manner as to encircle a little more than one-third of the thigh, and it was carried down through the fascia to the muscle. Within a few minutes the extremity operated on was cold and bluish. So far as could be noted there was little difference in the animal having the simple ligation and the one having the incision around the thigh. First, there was spasticity of the extremity with rather flaccid paralysis of the digits, but of such a nature as to make the animal tend to curve its toes under. This deformity simulated the main-en-griffe deformity in the human being, and was maintained for from six to nine days. The

dogs with simple ligation of the vein maintained the deformity slightly longer than those with the partially encircling incision.

In the next series these two operations were combined. Almost the same results were obtained as in the two previous series, except that the deformity lasted a few hours longer.

From the results of these experiments it was concluded that ischæmic paralysis did not depend wholly on the procedures that had been employed. Accordingly, after the wounds had healed an Esmarch bandage was applied fairly tightly above the knee at the site of the initial operation, fastened in place with adhesive, and left on for from six to twenty-four hours.

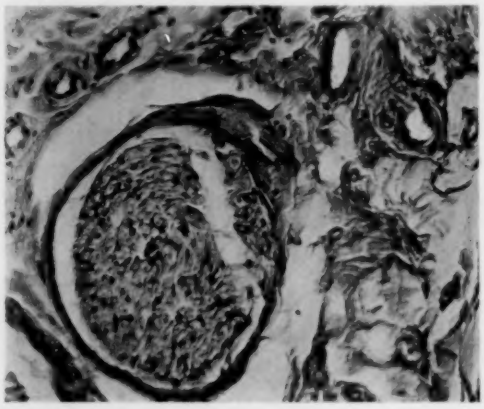

FIG. 4.—Cross-section of muscular tissue from ischæmic extremity of dog H90 (hæmatoxylin and eosin, × 120).

One of the animals was left with a deformity typical of ischæmic contracture and similar to that in man. The forefoot and distal phalanges were flexed while the proximal phalanges were extended. This simulation of the typical contracture was not persistent in all of the dogs. However, the animal which wore the bandage the longest maintained the deformity for more than eighteen months with no signs of improvement. The leg gradually wasted away and became hard and board-like as in the human being. When the animal attempted to put the foot to the ground, only the tips of the toes would touch and there was considerable resistance in the muscles. With exercise the deformity increased and the dog limped about as he did immediately after the application of the bandage. Another animal on which the bandage was kept for several hours still had the deformity at the end of two months, but after that he gradually improved.

A method of producing a lesion which appeared similar to that in man having been developed, the next procedure was to determine, if possible, a method of preventing such deformity. A dog in which the incision and ligation had been performed was selected for this experiment. An Esmarch bandage was applied above the knee and left on for eight hours. At the end of this time there was considerable œdema and other signs of a sluggish circulation, and the toes were contracted. Six hours later the wound was opened and the blood and serum were evacuated. Two rubber tubes for drainage were placed deep in the intermuscular space and sutured. The following day the swelling had gone down markedly, and four days later the dog was walking normally. This was in marked contrast to the condition of the control animals in which drainage had not been instituted. The

experiment was repeated often enough to bring out the fact that intrinsic pressure is a factor which must be dealt with in this condition.

Correlation of Former Findings with Present Findings.—In the pioneer study of the affected muscular tissue made by Leser, loss of nuclei of the muscle fibres and an increase in connective tissue is described. Petersen reported similar findings. Bernays, who was the first to report the microscopic findings, observed the loss of the nuclei and of the transverse striations of the muscles. He also found some atrophy of the muscle fibres. Most writers speak of the hardness and yellow color of the muscles and also of the tendency for the tendons to mat together.

In one dog the typical main-en-griffe deformity was produced and has been maintained for more than eighteen months with no signs of improvement. This was the typical contracture deformity. On careful examination of this animal the first thing noticed was the contraction deformity of the extremity operated on. This dog was given especial attention as he was the only animal to maintain the typical deformity for more than a year. When he was taken from his kennel he apparently walked normally, but after a dozen or more steps he began to limp, and walk favoring the right pelvic limb. The toes were curved back and seemed colder than those on the left leg. The measurements were as follows:

	Right side, cm. (side of operation)	Left side, cm.
Ball (above the toes)	6.5	7.0
Instep	19.0	22.0
Knee	22.0	24.5
Above the knee	23.0	25.7

There was noticeable wasting of the muscles similar to that seen in man. The animal was anæsthetized and when the muscles were carefully dissected the blood-vessels were found to be markedly enlarged above the site of the former operation. At the point of the old operation all the structures were matted down with scar tissue. The blood-vessels were the size of fine threads below the operative scar and the nerves were flattened and darker than those in the control leg.

The vessels of the extremity operated on (Fig. 1) were injected almost immediately, but it was impossible to get the lightest suspension of barium sulphate under high pressure through the vessels. The solution stopped at the cicatricial scar. However, when the control extremity was injected with barium sulphate the vessels were quickly filled with the suspension, as would be expected (Fig. 2).

Histologic study of muscular tissue from the ischæmic extremity showed a marked increase in the intermuscular nuclei which have arranged themselves in rows, and variation in the size of the muscle fibres and some decrease in muscle striations (Fig. 3). A cross-section shows proliferation of the endothelial cells lining the smaller blood-vessels, almost approaching the point of occlusion in some places, and definite thickening of walls of all the blood-vessels, especially the small vessels. Many cells present the characteristics of fibroblasts, an increase in connective tissue is seen, also some loss of the nuclei of the muscle fibres (Fig. 4).

Microscopic examination of the nerves from the ischæmic extremity (Fig. 5) revealed the well-marked degeneration of some of the fibres (light gray) and the intact state of others (dark gray). There was definite, but not as extensive, degeneration as in a nerve which has been actually cut. In certain areas there was slight swelling of the myelin and in other areas almost complete disappearance of it (Fig. 6).

The histologic features of muscle atrophy have long been studied. I found, as have others, an increase in the amount of connective tissue (Fig. 3). The number of intermuscular nuclei was increased. In some sections there was an increase in adipose tissue (Fig. 4). The muscle fibres were usually diminished in size, but occasionally there was an hypertrophied fibre.

Discussion.—It appears that direct injury to the nerves may frequently occur, but it has not been proved that such injury is the primary cause of the typical main-en-griffe deformity. There must be some other causative factor. It is true that the involvement of the intrinsic muscles of the hand can be explained only by direct injury to the ulnar nerve, but as a rule injury to some other tissue precedes injury to the nerves. In the forearm the ulnar nerve is the one most commonly affected. The explanation of delayed ulnar palsy is that peripheral neuritis develops some time after the injury.

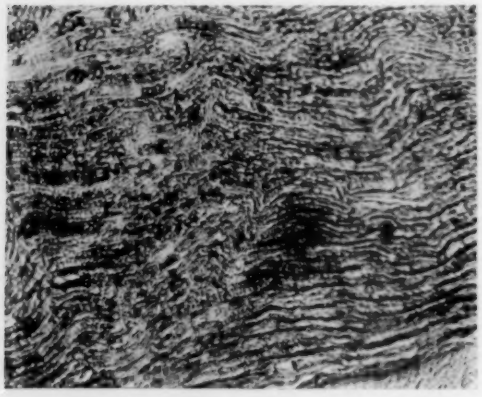

FIG. 5.—Longitudinal section of nerve from ischæmic extremity of dog H90 (Weighart-Pal, × 120).

The almost universal involvement of the flexors but not of the extensors may be explained on anatomic grounds. On the anterior surface of the forearm the soft tissues, composed of the flexor muscles, arteries, and nerves, overlie the radius and ulna, forming a good-sized pad. Besides this, the body of the anterior flexor muscles comes in direct contact with the source of the injury, whether it be the splints, cast, bandages, or direct force. The ulna is situated between the splint and the extensor muscles and protects these muscles from the injury of a splint.

No other structures are more susceptible to injury than the nerves. With their close proximity to the blood-vessels, a constriction lasting for a long time and sufficient to close the large blood-vessels of the brachial region must of necessity exert marked pressure on the median and ulnar nerves, and induce neuritis with subsequent degeneration of the nerve. The extensor muscles do not suffer because the musculospiral nerve which ultimately distributes branches to this group of muscles is deeply placed in the upper arm between the triceps muscle and the humerus. In the region of the elbow-joint the nerve is protected by its position between the long extensors of the forearm. It is, therefore, not subjected to as much trauma as the other nerves because of their superficial position in the upper arm.

Embraced as it is by the pronator radii teres muscle, the median nerve is subjected to practically the same injurious forces as the muscle. Therefore, if pressure over this muscle and its associated group is sufficiently great to cause profound ischæmia, the nerve must share the fate of the muscle

which encloses it and suffer degenerative changes to some extent. Flaccid paralysis at the first, followed shortly by the contraction deformity, would suggest primary injury to the nerves but in all probability there is also injury to the muscle, which helps to form the contracture and resulting deformity.

On the other hand, the acceptance of a primary myositis and a neurogenic origin for this type of contracture would explain cases of Volkmann's ischæmic contracture in which no fracture occurred or in which no profound changes took place in the muscles. The site of the lesion may often be indicated by the scar on the forearm.

If a fracture or injury occurs in the region of the elbow-joint, the tissues are bruised and effusion of blood and serum follows. The tension in the subfascial zone in the forearm can be so great as to cause cyanosis of the whole forearm and hand. A blood clot forms in the tissues, and inflammation follows with a deposit of the inflammatory products in the tissues. This deposit in itself will cause pressure and have the same effect as a tight splint or bandage.

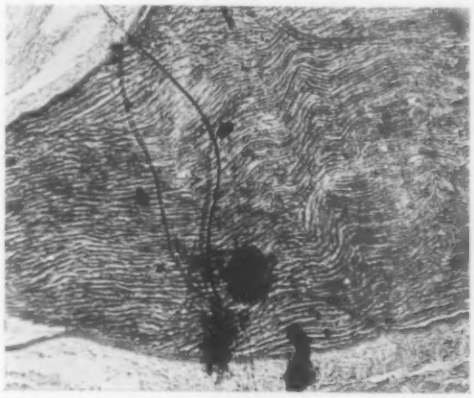

FIG. 6.—Cross-section of nerve tissue from the ischæmic extremity of dog H90 (Weighart-Pal, ×120).

Muscles completely deprived of their oxygen supply finally disintegrate, but in a typical case of Volkmann's contracture the deprivation of oxygen is not complete. There is ischæmia, the blood supply is cut down far below normal, reducing the nutrition to the muscles, and as a result the resistance of the extremity is lowered. In the specimens studied during this experiment, the calibre of the blood-vessels was so markedly reduced as to prohibit the flow of the solution used in an attempt to make a röntgenogram of the circulatory tract of the extremity.

It can be understood from the discussion that no one factor is responsible for the production of the typical deformity seen in a case of the Volkmann-Leser ischæmic contracture. It would seem from these experiments that the deformity in the human is usually produced somewhat as follows: First, there is an injury of some extrinsic nature in the region of the elbow-joint, or to the humerus or bones of the forearm, consisting of a fracture or an injury to the soft parts only, or both; or fracture of a clavicle, and so forth. Splints, casts, or bandages may or may not be applied. When splints are used pressure sores often develop, usually coming over the flexor muscles which predispose to the formation of scar tissue. But pressure sores are not required to bring about the deformity. The tissues are bruised by the trauma and extravasation of blood, and serum follows. The tension may be so great as to cause cyanosis of the entire forearm. This intrinsic pressure

causes local myositis and then a pressure on the nerves (usually the median and ulnar) and the blood-vessels. There develops a flaccid paralysis followed by swelling in the muscles. Almost immediately contraction of the flexor muscles begins, resulting in the main-en-griffe deformity originally described by Volkmann. As the condition goes on, due to the diminished blood supply, the flexor muscles begin to atrophy and the tendons become matted together. When the wrist is hyperflexed the fingers can be straightened out. If the intrinsic pressure is relieved within a short time after the formation of the hæmatoma, the patient will usually recover.

SUMMARY

The lesion of ischæmic paralysis as seen in man was reproduced in animals by bandaging one extremity and by preventing the return of the venous blood. In an attempt to prevent the development of the deformity, it was found that if drainage was instituted within a few hours after carrying out the procedures leading to the development of the lesion, contracture did not ensue, or was very slight. The results of these experiments would seem to indicate that the contracture deformity is due to a combination of factors, the most important of which are impairment of the venous flow, extravasation of blood and serum, and swelling of the tissues with consequent pressure on the blood-vessels and nerves in the involved area. If this is true, early drainage would be of value.

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MECHANICAL DERANGEMENTS OF THE JOINTS*

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Disability due to mechanical derangement of the joints is not uncommon and, since the disability occurs most often in men during the active and productive period of life, it is of distinct significance in industrial surgery. If the joints in the lower extremities are involved, the disability is usually greater and, in case of a hazardous occupation, a fall or slip may result in a serious or fatal accident. This is particularly true of structural steel workers, miners, and railroad men who seek relief more on account of the danger of such a fall or slip than of the distressing pain due to the derangement. The type of derangement which is entirely due to mechanical and not infectious causes, varies according to the anatomic structure of the joint concerned.

The Ankle-joint.—Because of the structure of the ankle a fracture of the bones above or below the joint usually occurs before displacement of the joint itself.

Slipping Peroneal Tendon.—Occasionally there is a somewhat rare condition in the ankle in which the peroneus longus tendon is displaced from its groove in the external malleolus, and slips upward and to the outer side of the external malleolus. It is most often seen in athletes, baseball players particularly. The displacement occurs by internal rotation of the foot, with plantar flexion as the action of swinging at the ball is completed. If the dislocation becomes habitual, it is necessary to expose the lower end of the malleolus, replace the tendon in its groove, and turn down a flap from the fibula, consisting of the periosteum and fibrous tissue, and sew it to the periosteum of the os calcis.

The Knee-joint.—Mechanical derangements are more common in the knee than in any other joint in the body. If one considers the anatomic structure of this joint, merely the expanded ends of two long bones, one must marvel at the remarkable stability afforded by such an arrangement. A most ingenious set of ligaments is provided and these with muscle tonicity afford stability throughout the entire range of motion. There is one weak position, however; that is when the knee lacks 20° to 25° of complete extension. In this position the ligaments are relaxed considerably and a certain amount of mobility and instability permits slight rotation of the tibia on the femur and slight lateral motion. It is in this position that most of the injuries to the semilunar cartilages are sustained, although some authorities contend that damage may occur with the knee in full extension.

* Read before the Chicago, Rock Island and Pacific Railway Surgeons, October 12, 1926.

The Semilunar Cartilages.—The internal semilunar cartilage and the external cartilage are probably affected 20:1, respectively. The semilunar cartilages are fibrocartilaginous in structure and rip or tear in their longitudinal axis rather than fracture transversely, although fracture may occur.

The usual history given by a patient with derangement of the internal semilunar cartilage is that while engaged in some sport or active occupation the knee suddenly caught in partial flexion, throwing him to the ground. Severe pain appeared immediately and on attempting to rise and extend the knee, he found that extension was impossible. He was able finally to manipulate and force the knee straight himself, or some friend pulled on the leg forcing the knee into place with a distinct pop. Complete reduction is always accompanied by great relief, the patient describes the joint as being "in" or "feeling right." Similar attacks usually follow and the locking becomes habitual. After the initial attack, there may be considerable swelling, but, as the attacks become more frequent, the swelling is less noticeable and the disability following the locking is less.

Various types of fracture of the semilunar cartilage have been described. Sometimes there is a loose flap which slips back and forth occasionally, catching between the internal condyle and the tibia. This flap is usually in the anterior portion and attached well forward. If it is in the posterior portion it may be impossible to see through an anterior incision, and the surgeon may be forced to admit that he has not found a lesion. Because of the clear-cut history he may remove the anterior portion of the cartilage in spite of this lack of definite pathologic lesions. If typical symptoms of derangement persist, it may be best later to remove the posterior portion through a posterior incision. When there is a clear history of locking, a torn cartilage will usually be found and anything short of such findings should fail to satisfy the surgeon.

When the surgeon is called on to reduce a dislocation of the semilunar cartilage, he may be unable to afford complete extension of the knee, and the patient will volunteer the information that the knee still "feels out." This means that the displaced portion of the cartilage still lies in the mesial part of the joint and that in all probability a loop, or bucket-handle, type of fracture exists. Typical locking and slipping, due to the pedunculated anterior tear, previously mentioned, when the patient speaks of "the knee going out of joint," readily establishes the diagnosis of a damaged internal semilunar cartilage. In the form usually unrecognized, that is, the loop or bucket-handle, there is persisting inability completely to extend the knee following the initial locking. The patient may be able to get around, if his duties are not too strenuous, but full extension will still be lacking and there will be a feeling of insecurity in the knee. These symptoms are caused by the looping of the torn portion of the cartilage, in the intercondylar notch, it still being attached anteriorly and posteriorly. (Fig. 1.) If the internal semilunar cartilage is at fault, there is usually tenderness on the inner side of the knee, just anterior to the internal lateral ligament. Occasionally the pain is

referred to the posterior part, and possibly to the outer side. The internal semilunar cartilage is firmly attached to the periphery of the joint and its substance will tear rather than be torn from this firm mooring. The external semilunar cartilage, on the other hand, is loosely attached and will sometimes be torn from the periphery before it is torn itself; therefore, it is more common to find the external semilunar cartilage rolled or bundled up in the external compartment with very little damage to the cartilage itself.

Loose Bodies.—Osteocartilaginous bodies are often found in the knee-

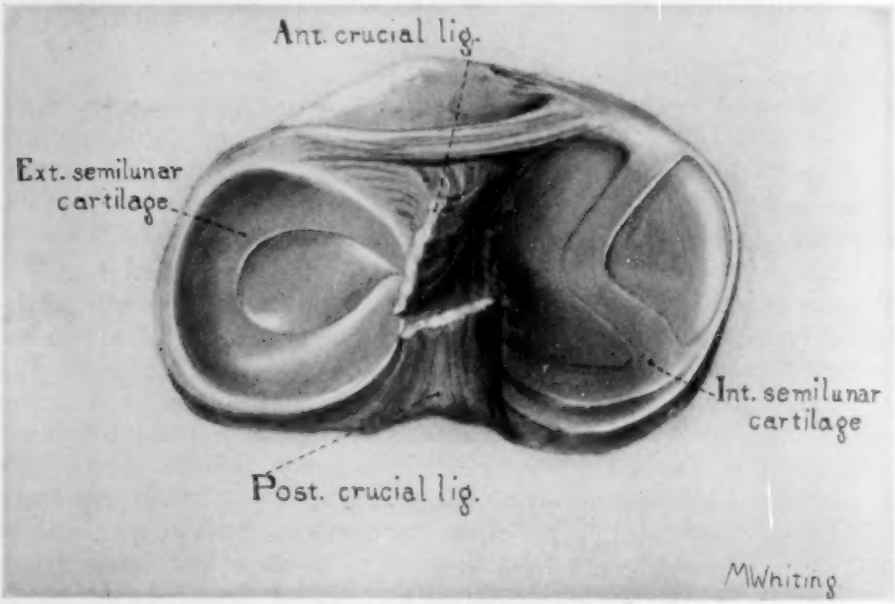

FIG. 1.—Internal semilunar cartilage displaced outwardly; anterior portion blocking extension. Bucket-handle type.

joint. In elderly persons with osteo-arthritis, some of the osteophytes may break off at the margin of the joint, wander about in the joint, and increase in size, being nourished by the joint fluid. They cause an occasional locking of the knee, which, however, is not as severe as that caused by the semilunar cartilages.

In young persons, osteochondritis desiccans may be the cause of the loose bodies, which originate in the internal condyle of the femur, just anterior and internal to the insertion of the posterior crucial ligament. This desiccating area may be large and throw off two or three bodies, or it may be small and throw off only one. The body or bodies may occasionally slip back into the original position and give no trouble for some months. The bodies are sometimes found in both knees. Their cause is unknown.

Occasionally the synovial membrane becomes hypertrophied and thickened, and as a result free, loose bodies form; this process is called osteochondromatosis. (Fig. 2.) The bodies may be quite numerous, as many as 1000 having been removed from one knee. Osteochondromatosis is best

explained on a neoplastic theory, the condition being a non-malignant form. At the margin of the joint where the synovial membrane is reflected cell differentiation may not be sharp, and certain embryonic cells of cartilage and bone may be implanted in the synovia and later form cartilage and bone. As the new growth bulbs get bigger and heavier, they fall off and wander about the joint. A study of the histology of these bodies shows that when still attached by a pedicle to the synovia and thus assured of a blood supply there is active proliferation of bone as evidenced by the presence of osteoblasts. When the bodies are free and wandering there is no evidence of active formation of bone, but the cells at the marginal cartilage are normal and evidently cartilage is being formed. (Fig. 3.) This indicates that the bodies are being nourished by the synovial fluid.

FIG. 2.—Osteochondromatosis of the knee-joint.

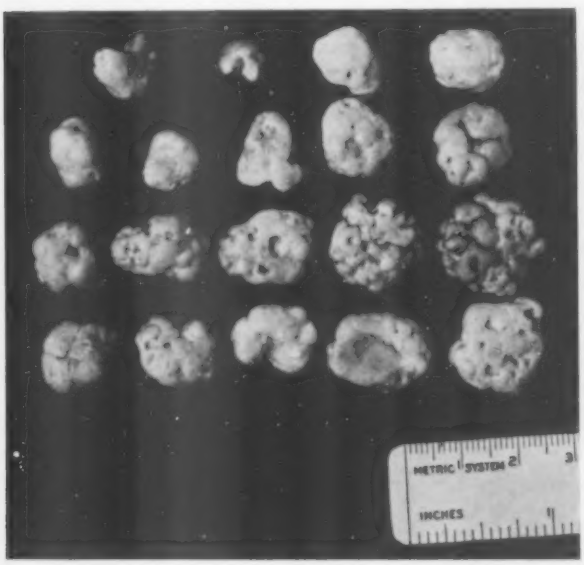

FIG. 3.—Nineteen loose bodies removed from knee-joint (osteochondromatosis.)

The presence of a loose body in the knee demands its removal, other things being equal. Occasionally, under local anæsthesia and the proper aseptic surgical conditions, one is able to isolate the body and, by plunging a sharp, cutting needle into it, hold it securely. It may then be removed readily by carefully cutting down along the needle. The body may be situated in any part of the joint, and, when lodged in the posterior compartment, either an external or internal posterolateral

incision makes the removal comparatively simple. Complete exposure of the interior of the knee-joint is not possible. The split patellar incision should be reserved for only those cases in which a thorough exploration of the suprapatellar pouch and the anterior portion of the joint is necessary. Contrary to what one would expect, the exposure of the semilunar cartilages by this incision is not at all satisfactory; an anterior internal or anterior external incision is preferred for the inspection and removal of the menisci.

Habitual Dislocation of the Patella.—Slipping patellas may be the cause of mechanical derangements of the knee-joint in women, but rarely in men. The dislocation is always outward. The diagnosis is not always easily made from the patient's description. The pain and disability are so great that powers of observation are diminished. Not infrequently the patient insists that the dislocation occurs inwardly, the prominent internal condyle of the femur no doubt being mistaken for the patella. When a muddled description is given by the patient, a simple test will sometimes clinch the diagnosis. With the knee in full extension and the muscles relaxed, gentle pressure outward on the patella so as almost to tip it over the edge of the external condyle and then slight flexion of the knee, will at once cause the patient to assert that the sensation is similar to that when the knee "goes out." If dislocations are frequent and, as is so often the case, both knees are involved, the patient will readily submit to operation for relief. Not infrequently there is a history of the same condition in another female member of the family. The operation preferred is transferring the insertion of the quadriceps inward, so that on contraction of the quadriceps there will be a tendency to pull the patella inward.

The Hip-joint.—Snapping Hip.—Authorities differ on the exact pathologic change present in the snapping hip. One type is the result of the slipping forward of the trochanter along the margin of the tensor fasciæ femoris. The operation suggested is to cut down on the border of the tensor fasciæ femoris, divide it transversely, and sew the lower part of the fascia behind the trochanter. I have not found the results entirely satisfactory, perhaps because of the difficulty in ascertaining the lesion back of the complaint. A slipping of the head partially over the margin of the joint may take place, but in such case nothing can be done. The disability is usually not great. In some persons the acetabulum is shallow and it is possible that in some an enlarged ligamentum teres may so fill the socket as to render the joint somewhat unstable.

Loose Bodies in the Hip.—In rare instances loose bodies are found in the hip-joint. They cause varying degrees of disability, including catching and locking. If the bodies are disclosed by the röntgenogram they should be removed through either an anterior incision or a Kocher posterior incision. The latter is quite satisfactory, as the head of the femur can be displaced completely and the cavity of the joint can be emptied. The loose bodies usually arise at the margin of the joint, where the synovia is reflected, as in other cases of osteochondromatosis.

Fingers.—Trigger Finger.—Trigger finger is sometimes described by patients as "something wrong with the joint." The lesion is either a constriction in the sheath of one of the flexor tendons of the finger, usually of the middle or ring finger, or an enlargement of the tendon within the sheath, which causes obstruction to the extension of the finger, which catches in semiflexion. On pulling or violently extending the finger, it straightens with a snap-like action. The lesion is usually in the metacarpophalangeal region. In persistent cases it may be necessary to open the sheath and remove the obstruction.

The Wrist.—Habitual Displacement of the Ulna.—Habitual displacement of the lower end of the ulna inwardly and posteriorly may follow certain injuries to the wrist, causing rupture of the radio-ulnar ligament. The disability is considerable and may necessitate operative interference. Dislocations may be prevented by drilling holes transversely through the lower end of the radius and ulna, and slipping a free strip of fascia lata through the holes (Hoke), thus forming an artificial ligament which holds the ulna in place.

The Elbow.—The elbow-joint is stable and fractures of the bones making up the joint are more common than dislocations.

Dislocation of the Head of the Radius.—If the orbicular ligament is ruptured, the head of the radius may obstruct flexion. A slipping sensation may be felt by the patient. Plastic surgery is impracticable and the excision of the head of the radius is the only means of relieving symptoms.

Loose Bodies.—Osteocartilaginous bodies may form in the elbow and cause catching or locking of the joint. They are usually due to osteochondromatosis and vary in number from two or three to several hundred. The common initial symptom is lack of complete extension; this coming on in an elbow insidiously, with no signs of arthritis, should lead to a suspicion of loose bodies. Röntgenologic examination will establish the diagnosis. If the symptoms are severe, the bodies should be removed. The joint may be opened, by slitting the olecranon transversely and forcing the articular end of the humerus through the opening, but one hesitates to employ such radical measures. By making small external and small internal incisions, and carrying the dissection close to the humerus, the anterior compartment can be emptied; the posterior compartment can be evacuated through a split in the triceps.

The Shoulder.—Recurrent Dislocation.—Habitual dislocations of the shoulder are more common in men, and are particularly troublesome if they are engaged in occupations which demand active and strenuous work. The dislocation occurs anteriorly and inferiorly through a rent or tear in the capsule at the capsular margin, the head of the humerus slipping out below the subscapularis and dislocating upward beneath the coracoid process. The dislocation rarely occurs posteriorly. The cause is doubtful, but it may be ineffectual repair of the rent in the capsule following an ordinary traumatic dislocation. Occasionally the disability will disappear with prolonged fixa-

tion, but, if the habit of dislocation is well established, luxation may occur on trivial movements and at inopportune times. In such cases, operation offers the only chance of permanent relief.

Capsulorrhaphy is the usual treatment, but in our cases following this procedure recurrence has taken place in more than 50 per cent. Clairmont advocated swinging the posterior portion of the deltoid forward through the quadrilateral space and attaching it to the coracoid process, the purpose being to have it act as a sling to support the head. Our results from this operation were also unsatisfactory. We have had no experience with the Hildebrand deepening of the glenoid fossa posteriorly, or with the Eden method of bone grafting along the anterior border of the fossa. On the theory that, if the head of the bone can be prevented from travelling downward, dislocation will be prevented, we are now using a tenosuspension method in which the head of the bone is suspended to the acromion process by the aid of a free graft, made from the peroneus longus tendon. The tendon is placed through holes bored in the acromion process and the head of the bone. (Fig. 4.) The peroneus longus tendon is not essential in its original position, its function being carried on by the peroneus brevis, and it makes an excellent large piece of tissue for an artificial ligament.

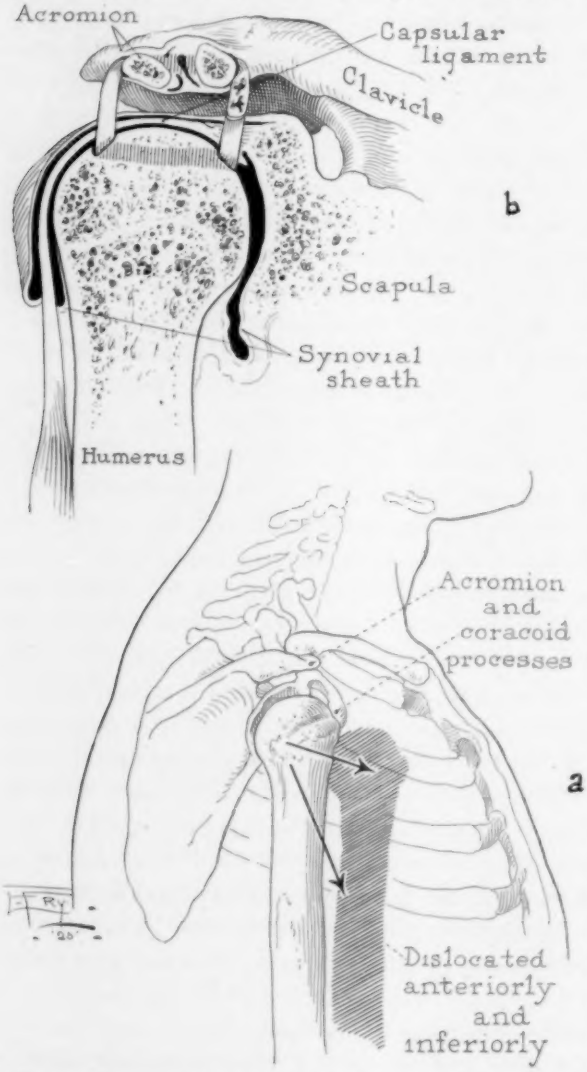

FIG. 4.—Tenosuspension for habitual dislocation of the shoulder.

Loose Bodies.—Osteocartilaginous loose bodies may be present in the shoulder-joint, although rarely. When present they may be quite troublesome and painful. A posterior incision is preferred since the bodies may be

worked out through it. Complete exposure of the joint is not practical. The symptoms are catching or semi-locking and the patient may insist that the joint "goes out."

Acromioclavicular Dislocations.—Acromioclavicular dislocations are not uncommon. Strapping is of no benefit, and, if the luxation is sufficient to cause the patient discomfort, operation should be resorted to. By drilling holes through the acromioclavicular joint and fastening a piece of fascia lata through these holes, sufficient stability is given to the joint to prevent further dislocations.

Sternoclavicular Dislocations.—Sternoclavicular dislocations are also troublesome and once the habit of dislocation is established, the only relief is through operation. Usually an artificial autogenous ligament is used, a piece of fascia lata being inserted through holes bored in the sternum and clavicle.

CONCLUSIONS

Mechanical derangements are most common in joints in which stability and function depend chiefly on the action of muscles and the strength furnished by ligaments; the knee and shoulder are examples. Such joints as the hip, elbow, and ankle, in which good, bony support is provided, rarely give trouble.

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TUBERCULOSIS OF THE THYROID GLAND

A REVIEW OF THE LITERATURE AND REPORT OF FIVE NEW CASES

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The literature on tuberculosis of the endocrine glands has been scant, largely because of the rarity of this disease in these organs. Tuberculosis of the thyroid gland is a rare condition. The great pathologists in the middle of the nineteenth century, Virchow and Rokitanski, had by their writings great influence on continental authors at that time regarding thyroid tuberculosis; the former stated in his earlier writings that there was some antagonistic action between goitre and tuberculosis and that the presence of a goitre was proof that the subject was not tuberculous; Rokitanski made the positive statement that the thyroid gland was never invaded by tuberculosis. The effect of these statements is reflected in the publications of writers on this subject in the latter part of the century, so that practically every encountered case was recorded. The number of reported cases of thyroid tuberculosis has increased considerably in the last thirty years as thyroidectomy has become more common and the tissues systematically studied in a routine manner by the pathologists. However, the total number at the present time is not large and the condition is not well known to the profession in general.

There has been no comprehensive study of the literature of this subject in the English language since 1917, and we shall, therefore, summarize in a brief but fairly comprehensive manner the recorded cases of tuberculous disease of the thyroid gland, adding five clinical cases with operative findings; and presenting some views on the clinical aspects in the hope of crystallizing current ideas.

Before proceeding with an examination of the recorded cases a brief description of the main pathological facts is essential. When the thyroid gland is invaded by the bacillus tuberculosis, the lesion presents one of two forms which do not differ importantly from the reaction of defense against tuberculosis of other parenchymatous organs. The common and less important type from a clinical and diagnostic standpoint is the miliary form. In this condition the gland is studded with tubercles as large as one millimeter in diameter and as small as to be invisible with the unaided eye. When visible the tubercles are gray or yellow in color and are given excellent contrast by the dark red stroma of the gland which may be hyperæmic. Usually the tubercles are microscopic. This type of reaction is always associated with general systemic tuberculosis and is essentially acute in type.

The second type of reaction to the bacillus is of a more chronic type and is

caseating to a greater or less degree, depending on the vascularity of the gland, the duration of the infection and the relative virulence of the infection with respect to the defense of the host. The primary form of this type probably is always that of a tuberculous granulation tissue consisting of young connective tissue, epithelioid cells, mononuclear cells and the Langhans type of giant cell. The immediate precursor of this type is probably a conglomeration of miliary tubercles. The gland in this condition is involved in gross tuberculomata, varying from a hazelnut to a large fist in size. The tuberculous granulation tissue under the influence of the factors mentioned above undergoes degenerative changes either of necrosis and softening to form masses of tuberculous caseated material or of liquefaction to form a cold abscess. This type of tuberculosis does not respect anatomical boundaries and the tissues of the neck are involved in the infiltration of the progressively advancing tuberculous granulomatous tissue. This will account for fixation of the thyroid in many, but not all of the cases.

A classification of this type of thyroid lesion depending on the coexistence in the thyroid gland of other types of pathology has been used extensively by the German authors and described particularly by Ruppaner.[35] He differentiates chronic caseating tuberculosis in a normal gland (known as *struma tuberculosa*) from the same pathology in a nodular goitre, called *strumitis tuberculosa*. It is interesting that the majority of cases of caseating tuberculosis occur in the adenomatous type of gland and that it occurs more frequently in a normal gland than in the hyperplastic thyroid of exophthalmic goitre. It is suggested that vascularity is a probable cause of this predominance since in an uncomplicated adenoma there is frequently necrosis, softening, cyst formation, hemorrhage, calcification as examples of degeneration due to avascularity. These, doubtless, provide the required *locus minoris resistentiæ*. On the other hand, the rich vascular supply of the thyroid in exophthalmic goitre is classical. In the hyperplastic thyroid the miliary type of lesion is encountered as a not extremely uncommon occurrence. It is interesting to speculate, therefore, as to the primary form of the chronic caseating lesion; it seems probable that this lesion begins in a miliary form and progresses by conglomeration in a gland of impaired resistance.

In addition to these two main types of thyroid reaction there is another described by the French authors, particularly Morin,[24] who discussed atrophy of the thyroid in tuberculosis and demonstrated it in 348 tuberculous cases. Of his cases with small thyroids there was little pulmonary improvement and he stated that enlargement of the thyroid is of benefit in tuberculosis. This type of pathology has also been discussed extensively by Roger and Garnier,[33] who found it in eleven out of twelve autopsies on tuberculous patients, and by Torri,[41] Kashiwamura,[20] de Quervain[15] and Costa.[12] This form is a thyroid sclerosis with increase of the connective-tissue elements in the gland and may apparently be either of an atrophic type, the volume and weight of the gland being less than normal, or of a hypertrophic variety, being greater than normal; of these the former is more common. This sclerosis is

seen in chronic tuberculosis, usually of the lungs, and is believed to be due to tuberculous toxins; it does not show the characteristic histology of tuberculosis and tubercle bacilli have not beeen isolated from these glands. Its only clinical significance is that in severe cases it may produce myxœdema. We have had no experience with this type.

Typical tuberculosis of the thyroid gland has been produced experimentally in animals. Roger and Garnier [33] infected the thyroid glands of rabbits and guinea-pigs by injection of a pure culture of tubercle bacilli into the carotid arteries. Torri showed that tubercle bacilli became attenuated when injected into animals after prolonged contact with colloid removed from human goitres. Tomellini [41] injected tubercle bacilli emulsion into the thyroid arteries of rabbits and produced tuberculosis. Shimodaira,[38] using a constant emulsion of tubercle bacilli intravenously in rabbits, produced tuberculous infection in the thyroid, spleen, kidneys and testicle and could by reduction in the number of injected bacilli produce infection in the last three organs and spare the thyroid. He concluded that the susceptibility of the thyroid to tuberculous infection is less than in the other named organs. Nather [26] also found that the tubercle bacilli were rendered less virulent to guinea-pigs when mixed with colloid obtained from goitres.

We have seen five instances of tuberculosis of the thyroid gland in a series of 1200 cases of thyroid disease treated by operation at the University Hospital between 1921 and 1926. One of these was an adenomatous goitre containing very large areas of active caseating tuberculosis. Two were adenomatous goitres in which miliary tubercles were found on routine pathological examination of the resected thyroid glands and two were of a similar type in glands which we classified as the Graves' constitution thyroid or exophthalmic goitre. In one of these last the miliary tubercle formation apparently developed in a ten months' period between hemithyroidectomies made essential by the extreme thyrotoxicosis.

ADENOMATOUS GOITRE WITH CASEATING TUBERCULOSIS

Case I.—A. P. A woman, aged twenty-four, entered the hospital complaining of dyspnœa on exertion, loss of weight and cardiac palpitation which had begun rather suddenly 18 months previously and had been associated with a relatively rapid enlargement of the thyroid gland in that time. She had had an enlargement of her thyroid gland since puberty. Her family history was of no clinical importance except that one sister had a goitre. There was no history of hæmoptysis, pleursiy, chronic cough, night sweats or any symptoms suggestive of tuberculosis. She had lost 11 pounds (4.9 kg.) in five years.

Physical examination showed a well-nourished, nervous woman with definite pallor of the skin. The thyroid was moderately enlarged in both lobes and had semi-elastic walnut-sized nodules in both upper poles and in the region of the isthmus. It was not adherent to the skin or adjacent structures. There were no bruits or thrills. There was no exophthalmos. No lymphadenopathy was palpable. The lungs were negative to physical and X-ray examinations. Basal metabolic rate were plus 2.5 per cent.

At operation both lobes were found large. The right lobe was entirely cervical. The left lobe was the same size as the right, but extended about 6 cm. below the level

of the superior thoracic aperture. Both lobes appeared to be composed of masses of adenomas averaging about 4 cm. in diameter with some calcareous degeneration in the periphery. The adenomas were degenerated and cystic in places. Subtotal thyroidectomy was done. The weight of the resected tissue was 170 gm. The post-operative course was uneventful except for a scantily draining sinus in the midline of the neck which persisted for two weeks.

Pathological examination by Dr. A. S. Warthin: "Adenomatous colloid goitre with

FIG. 1.—Case I. Lower power photomicrograph, showing the border of a mass of conglomerate tubercles. The neighboring thyroid tissue shows compression, increased stroma and slight mononuclear infiltration.

degeneration cysts. Old hemorrhages and calcification of vessels. There were also very large areas of active caseating tuberculosis."

Two years after operation this patient was in good health and had gained weight and strength. She had had no symptoms since her operation.

This is a case of chronic caseating tuberculosis developing in an adenomatous goitre and apparently cured by a subtotal thyroidectomy. It falls into the category of strumitis tuberculosa mentioned above. It is of interest because its nature was unsuspected prior to pathological examination of the tissue, because no tuberculous focus was discovered elsewhere and because of the excellent results obtained.

It seems well to discuss here the clinical significance of this type of lesion and with it the gross chronic tuberculous lesions of normal glands since they are clinically similar except for the history. It cannot be diagnosed with certainty before operation. Von Schiller's case [46] is one of two in the literature diagnosed before operation, and in this individual, known to have

chronic pulmonary tuberculosis, the author's suspicions were confirmed by exploratory puncture and the finding of tubercle bacilli in the obtained pus. One of Pollag's cases was also diagnosed correctly before operation.

Chronic thyroid tuberculosis assumes pleomorphic clinical forms. The literature shows that the very actively progressive form composed chiefly of tuberculous granulation tissue is extremely hard on palpation, invades and infiltrates the adjacent tissue, grows with extreme rapidity, and often involves the adjacent nerves, causing paralysis. It frequently causes pain, especially when it grows rapidly and expands the capsule. The pain is both local and referred to the shoulder girdle. It is produced by palpation and occurs spontaneously. This lesion may clinically resemble cancer, actinomycosis, some cases of lues or the form of chronic sclerosing thyroiditis described by Riedel as "ligneous thyroiditis."

This process, if less rapid in development and progress, and when accompanied by softening, caseation and necrosis, does not usually infiltrate, cause pain or paralysis. As in our case the gland may be soft and semi-elastic and under these conditions can be classified in its true category only with difficulty. It may resemble an uncomplicated adenomatous goitre.

If the process has gone one stage further, that is—to liquefaction, it will show fluctuation mimicing exactly a thyroid cyst arising either from a degenerated adenoma or from echinoccocus infection.

The symptoms of this lesion arise from a combination of pressure on the structures in the neck plus infection. It is our view that the only deviation from the normal as regards thyroid toxicity is in the direction of hypothyroidism and myxœdema, due to actual destruction of the gland acini. The pressure symptoms may be classified as follows: 1. Pressure on the skin and pre-thyroid tissues. v. Ruppener (Invasion and Infiltration.) 2. Rupture through the skin; Halstead. 3. Pressure on the trachea; *a*. Sudden, requiring immediate intervention; Clairmont, v. Ruppaner. *b*. Gradual, causing dyspnœa; many cases. *c*. Complete, producing asphyxia; v. Barth. 4. Rupture into the trachea. 5. Pressure on the œsophagus (dysphagia); many cases. 6. Rupture into the œsophagus; Rolleston. 7. Pressure on the recurrent nerve; Bruns. 8. Pressure on the sympathetic nerve (pupillary changes; Schwartz. 9. Rupture into a vein; Weigert. 10. Rupture into the mediastinum. Any of these signs may be found.

The signs of infection are those of infiltration of the deeper structures and detected by palpation; or changes in the skin or trachea evident to inspection. The signs of infection do not differ from tuberculosis of other parts of the neck, namely, a "matted" sensation, swelling without heat and redness only from hyperæmia as it approaches the skin or involves the trachea.

Persistent sinuses when found are suggestive of tuberculosis, but may be confused with the mycotic infections, syphilis, cancer after operation or a ruptured thyroglossal duct cyst.

Enlargement of the cervical lymph-nodes in both anterior and posterior chains were found to be present in a moderate number of the cases in the

literature. They were absent in our case. They are rarely enlarged in the miliary form.

Signs of tuberculosis elsewhere in the body are strikingly rare in the literature as well as in our own case. The presence of a general constitutional reaction to the infection is also a rare occurrence and such symptoms as marked emaciation, nightsweats, anæmia, afternoon elevation of temperature, and so forth, usually associated with a marked tuberculous infection are notable for their absence in the reported cases.

In résumé. Clinically the chronic caseating type of thyroid tuberculosis is very difficult of diagnosis, and this can be made only after a very careful clinical history with minute attention to physical findings and laboratory tests, and then is at best a rather hazardous supposition.

ADENOMATOUS GOITRES WITH MILIARY TUBERCULOSIS

Case II.—M. C. A woman, aged forty-two. A married housewife complained of "goitre, headaches and a rapid heart." Goitre first noticed twenty-three years previously, associated with her first pregnancy. It did not increase in size until her second pregnancy five years later, when it became markedly enlarged. She then used iodine for a long period. Two years prior to coming here the goitre again began to grow. For one year she had dyspnœa, tachycardia, palpitation and occasional slight precordial pain. In the family history it was noted that some of her mother's relatives had tuberculosis. She had had scarlet fever, followed by a chronic suppurative otitis media. There were no symptoms suggestive of tuberculosis.

She was a well-nourished woman with middle ear deafness and a perforation in the right tympanic membrane. The thyroid gland was diffusely enlarged and slightly nodular. It was soft and elastic except for a nodule the size of a chestnut in the anterior portion of the left lobe. The gland was freely movable. No bruits or thrills, no cervical lymphadenopathy. The lungs were negative on physical and by X-ray examinations. The basal metabolic rate was plus 20 per cent.

A subtotal thyroidectomy was performed under ethylene. The resected tissue weighed 310 gm. Pathological examination by Dr. A. S. Warthin: "Colloid goitre; marked excess of colloid. Local increase of connective tissue. Hyperplasia of the rudimentary lymph-nodes. Localized adenomas. One side of the compressed thyroid tissue contains a large number of recent, but well formed, miliary tubercles."

Convalescence was uneventful except for a slight sero-purulent discharge from the wound which persisted for thirteen weeks before healing, and a slight transient paresis of the right vocal cord.

A letter from her family physician, Dr. P. L. Hartman, two years after the operation, states: "She considers herself a well woman and has gained fifty pounds in weight. She is able to do a big day's work without getting very tired. When she takes cold there is a small enlargement above the end of the scar. This goes away entirely when her cold is better. At the time it is swollen it is very sore. There is no enlargement of the cervical lymphatics."

Case III.—R. W. A woman aged twenty-nine, a housewife, entered the hospital complaining of dyspnœa and palpitation. She had noticed an enlargement of the thyroid gland at the time of her first pregnancy nine years previously and it had increased in size during each of four successive pregnancies. She had nervousness for four years, especially in the year prior to entry in the hospital. Her neck had "felt stiff" for two years; she had dyspnœa and cardiac palpitation for two years. She had lost twelve pounds (5.3 kg.) in three years. Her past history was essentially negative except for

frequent attacks of tonsillitis. Three of her children had died shortly after birth with "eruptions" on their bodies.

Examination disclosed a fairly well-nourished woman with infected tonsils, a shotty anterior and posterior cervical lymphadenopathy, a fine tremor to the extended fingers, persistent moist râles at the base of the left axilla and a goitre. The thyroid gland was chiefly enlarged in the right lobe which was nodular; the largest nodule was the size of a hen's egg and semi-elastic in consistency. No bruits or thrills. No exophthalmos.

Wassermann reaction on the blood was four plus. Basal metabolic rate was plus 26. X-ray examination of the lungs was entirely negative.

A subtotal thyroidectomy was performed after anti-luetic treatment, and 140 gm. of thyroid tissue removed. Pathological examination (Dr. A. S. Warthin): "Adeno-

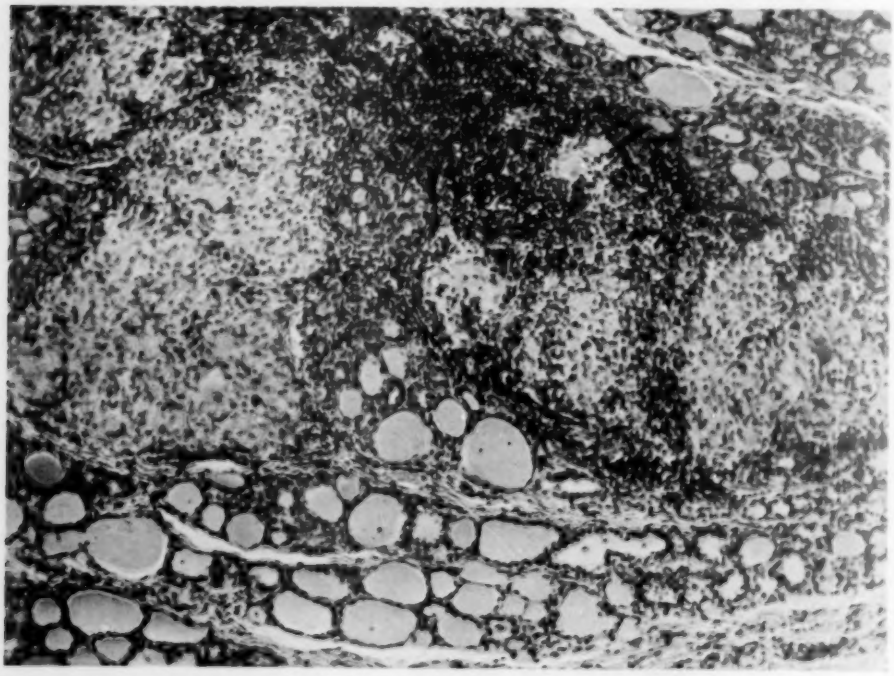

FIG. 2.—Case II. Low power photomicrograph, showing numerous epithelioid tubercles in the parenchyma of a colloid goitre.

matous goitre—multiple adenomas of the fetal type in various stages of retrogression. Connective-tissue hyaline. One portion of the thyroid has numerous miliary tubercles in it; several conglomerated into a mass. No epithelial hypertrophy or evidence of a Graves' constitution." The convalescence was uneventful and the wound healed by first intention. The patient returned to the clinic two years later for further anti-luetic treatment. "She states that her health has been excellent and she has been able to do her routine work since operation in a normal way. Has gained weight." There was no evidence at this time of any tuberculous process on physical examination.

These two Cases II and III illustrate the type of lesion where the miliary tubercle is found in an adenomatous goitre, and substantiates the previously well-established fact that there is no clinical method by which this form of tuberculosis can be diagnosed. In overwhelming infections with blood-borne tuberculosis in the clinical type described as acute miliary tuberculosis, the thyroid gland can usually be assumed to have miliary infection, but we wish

to emphasize that as such miliary tubercles produce no detectable changes locally or deviations from the thyroid function.

Our Case III, with conglomeration in one place of the miliary tubercles, suggests that this is an early intermediate phase between the miliary type and the chronic caseating type. It seems to us inconceivable that tuberculosis can be a primary lesion in the thyroid gland unless it is by direct innoculation through the skin and the pre-trachial coverings, and that it is always second-

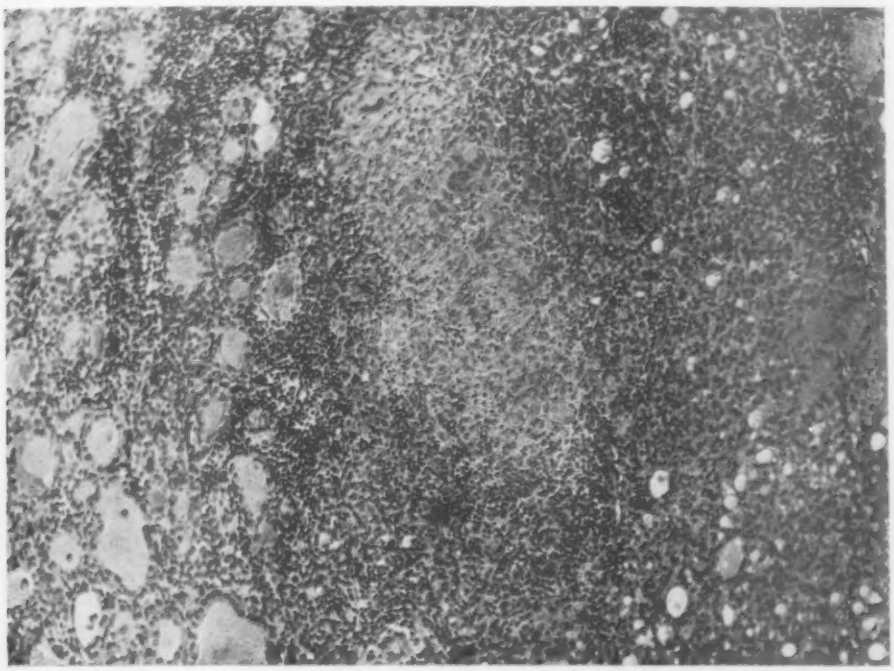

FIG. 3.—Case III. Low power photomicrograph, showing a large epithelioid and giant cell tubercle in an adenoma. The small acini of the adenoma are shown particularly on the left side of the field. There is a heavy mononuclear infiltration around the tubercle.

ary to some focus elsewhere, either hæmatogenous (the usual type) or from lymphatic extension or by direct extension, as from the cervical lymph-nodes. Now it would seem apparent from study of our Cases Nos. 2, 3, 4, 5, since the miliary tubercles were to a greater or lesser extent diffuse and since there was no demonstrable adjacent tuberculous infection that the infection in these cases was hæmatogenous.

GRAVES' CONSTITUTION THYROID WITH MILIARY TUBERCULOSIS

CASE IV.—I. C. A white housewife aged thirty-eight. Her present illness began seven months previously with palpation, dyspnœa, and excessive perspiration. These symptoms gradually increased and she lost twenty-five pounds (11 kg.) in six months. She has had "gas on the stomach without vomiting for six months." Slight enlargement of the neck recently. There was no family history of tuberculosis, one sister had goitre. She was slightly undernourished. The thyroid gland was only slightly enlarged and of a firm consistency, smooth and symmetrical. No bruits or thrills,

There was no exophthalmos, no palpable cervical lymphadenitis. Her lungs showed a few transient fine râles at the right base. The X-ray examination of her lungs was negative. The basal metabolic rate was plus 50 per cent., it fell to plus 15 per cent. after two weeks' rest in bed with Lugol's solution, 1 c.c. daily.

A subtotal thyroidectomy was performed. Pathological examination by Dr. C. V. Weller showed: "Colloid moderately abundant, but thin. Other colloid blue staining. Localized lymphoid hyperplasia. Epithelial hypertrophy. Small adenomas. Lugolized exophthalmic goitre. One of the adenomas is papilliferous in type. Through this thy-

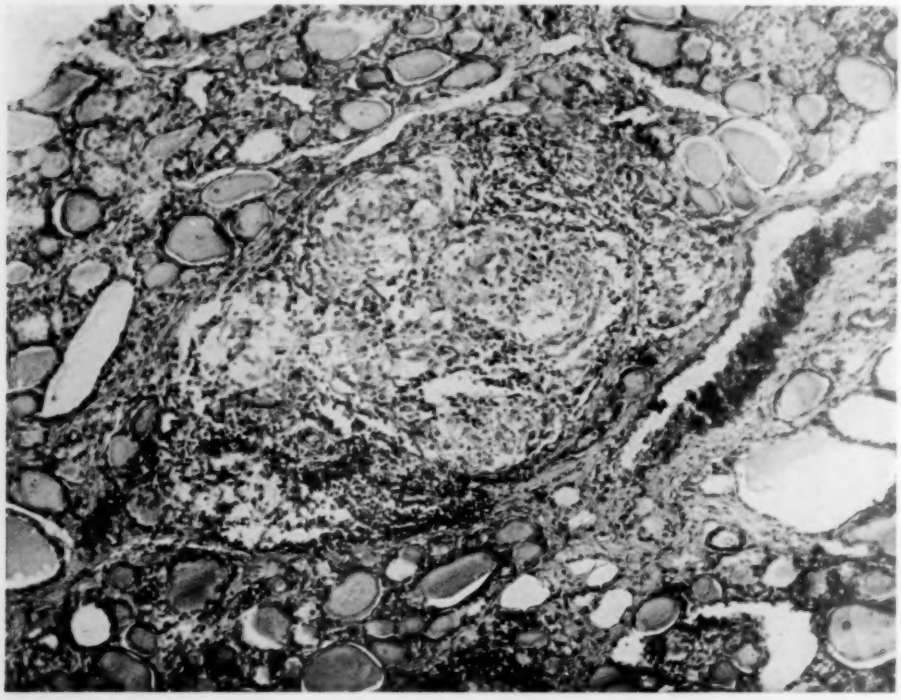

FIG. 4.—Case IV. Low power photomicrograph, showing a group of epithelioid tubercles. The surrounding thyroid tissue contains a moderate amount of colloid showing reduced consistency as compared with normal.

roid there are scattered epithelioid miliary tubercles." Convalescence was uneventful, except for auricular fibrillation for twenty-four hours on the second day.

CASE V.—L. R. A woman aged fifty-two, housewife. This patient came to the hospital because of very severe hyperthyroidism with tachycardia, palpitation, hyperhidrosis loss of weight, marked emaciation, nervousness, irritability, tremor and loss of hair. First noticed enlargement of the thyroid gland with prominent eyes twenty-five years previously; twenty years ago had an acute hyperthyroidism and she remained in bed for seven months at that time. The symptoms receded fairly well, but returned with their pristine intensity in 1923 after an attack of influenza. Her past history showed dyspnœa on exertion and an occasional œdema of the ankles, in a few years prior to coming to the hospital. Menopause in 1921. She had lost twenty pounds (9 kg.). There were no symptoms of tuberculosis.

Examination showed a middle-aged woman who was very nervous. She had a very marked exophthalmos with associated eye signs. The thyroid gland was moderately diffusely enlarged, soft without nodules and symmetrical. Marked bilateral thrills and bruits. Moderate cardiac enlargement. There was a slight percussion dulness with a few transient râles at the apex of the right lung entrance.

X-ray examination of the chest was essentially negative except for cardiac enlargement. Her basal metabolic rate in January, 1924, was plus 30.5 per cent. After rest in bed she returned to the clinic in March, 1924, with a basal metabolism of plus 76 per cent. A ligation of both superior thyroid arteries was then performed. In May, 1924, she had gained considerably in strength. Her basal metabolic rate was plus 50 per cent.; at this time an injection of absolute alcohol was made into the gland. In July, 1924, she again returned with only slight improvement and a second alcohol injection was performed. In January, 1925, her basal metabolic rate was plus 65 per cent. and in

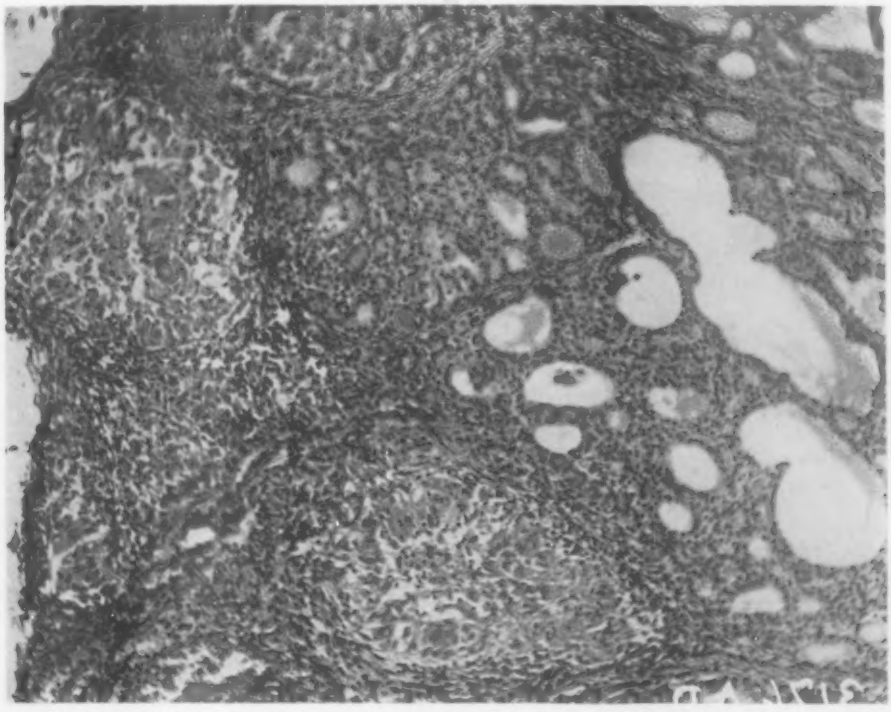

FIG. 5.—Case IV. A somewhat higher magnification of another field of the same thyroid as Fig. 4. Here the epithelioid tubercles are in close relationship with the parenchyma, showing deficient colloid and some epithelial hypertrophy. This is an exophthalmic goitre, showing some return of the colloid as a result of iodine treatment.

March, plus 75 per cent. In May, 1925, a right hemithyroidectomy was done; the removed tissue weighed 40 gm. Pathological examination by Dr. A. S. Warthin showed: "Exophthalmic goitre, small amount of colloid. Epithelial hypertrophy. Lymphoid hyperplasia." In July, her basal metabolic rate was plus 59 per cent. and in January, 1926, plus 60 per cent. In February, 1926, her basal metabolic rate was plus 75 per cent., and she was again admitted to the hospital with severe hyperthyroidism.

Examination of her lungs showed fine râles at both apices and dulness on percussion at the right apex. After rest in bed with the oral administration of Lugol's solution, 1.5 c.c. daily for ten days, the remaining lobe of the thyroid resected under ethylene anæsthesia. It was tremendously friable and vascular. The operation was followed by a blood transfusion. Pathological examination of this lobe by Dr. C. V. Weller showed: "Marked epithelial hypertrophy. Lymphoid hyperplasia. Slight amount of thin colloid varying in different areas. Lugolized exophthalmic goitre with active proliferation. Proliferating adenomas. Widely scattered miliary tubercles throughout." Convalescence was uneventful except for an auricular fibrillation lasting twenty-four hours.

A further study of the patient after the pathological report was received, disclosed no evidence of an active tuberculosis with the possible exception of the pulmonary apices. A reëxamination of the tissue removed at the first hemithyroidectomy was negative for evidence of tuberculous infection.

These two cases where the pathological findings were those of Graves' constitution thyroid, together with miliary tuberculosis, are particularly interesting since they again demonstrate that miliary tuberculosis may occur in the

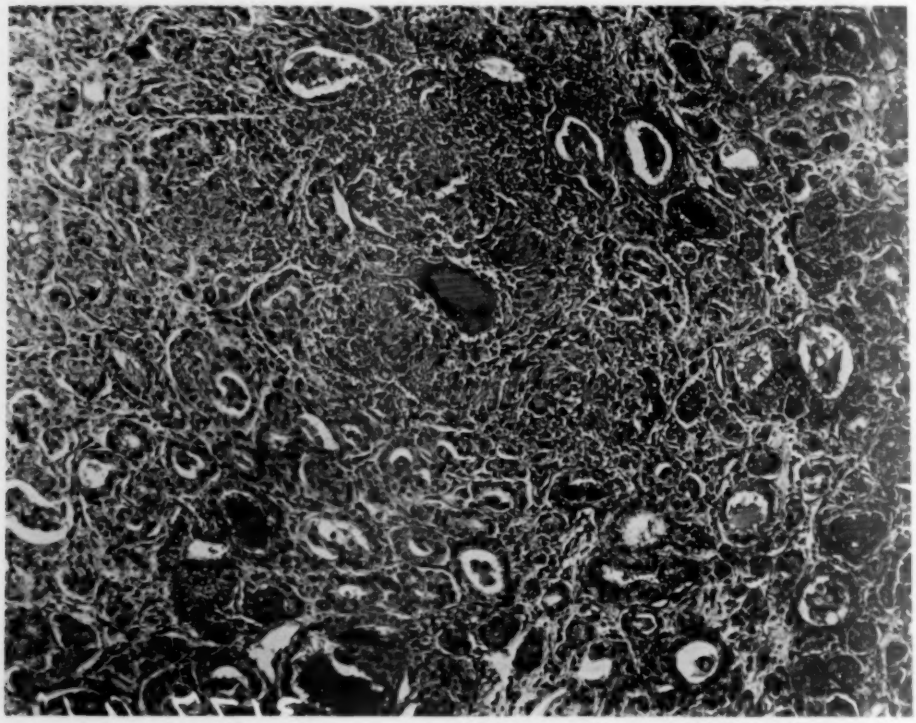

FIG. 6.—Case V. Low power photomicrograph, showing a miliary tubercle with a large giant cell. The parenchyma of the thyroid shows the scant amount of colloid and epithelial hypertrophy of an exophthalmic goitre following iodine treatment.

thyroid of individuals who have no signs of active tuberculosis. Both cases four months after operation are clinically negative for tuberculosis if one excludes the pulmonary findings at the apices in Case V and takes into consideration the fact that the X-ray examination of the lungs is normal and that there are none of the usual symptoms of a pulmonary tuberculosis in this case. These patients are practically well as regards their thyrotoxicosis.

Case V is particularly interesting since it is the only case in the literature in which the development of miliary tuberculosis in the thyroid gland occurred between consecutive lobectomies where there is recorded pathological findings of both lobes. As far as the clinical and metabolic studies of the patient and the pathological examination of the gland can determine, it is impossible in this case to detect any change in the degree of hyperthyroidism in this

patient's status at the beginning and at the end of the ten months' interval between operations.

Plummer and Broders,[27] in their discussion of this subject make the statement: "Either a hypertrophic gland is rendered more susceptible to invasion by the tuberculosis bacillus or the infection stimulates the parenchyma to an abnormal activity and is thus indirectly responsible for the hyperthyroidism with its attendant symptoms." In consideration of the latter part of this hypothesis it is evident from a study of the literature that an extensive tuberculosis of the thyroid gland produces no change in the function of the gland except in the direction of myxœdema, by destruction of the gland parenchyma; this is also confirmed in the cases of Plummer and Broders and they intimate that the greater the tuberculous involvement, the less the toxicity. There are many cases of mild and moderate caseous tuberculosis reported in the literature occurring in glands without hyperplasia. Moreover, the parenchyma of the experimental tuberculous thyroids in animals was not stimulated to a hyperplastic state. We believe for these reasons and from the study of our Case V which apparently indicates that there was no appreciable effect on the parenchymatous hypertrophy or its activity by the development of miliary tubercles in the gland, that the view that tuberculosis stimulates the gland to an abnormal activity is untenable.

The literature apparently does not bear out Plummer and Broder's first hypothesis if one considers the term hypertrophy to mean the gland of exophthalmic goitre. It is true that the adenomatous goitre apparently is much more liable to the invasion and development of tuberculosis than the normal or Graves' constitution thyroid, and it would appear a coincidence that tuberculosis appeared so frequently in the hypertrophic type of gland in their series.

Treatment.—We have found in our case of large caseating chronic tuberculomatous infection that excellent results followed subtotal thyroidectomy. This is in accord with the views of Lenormant,[23] Aubriot [2] and other modern writers.

Prognosis.—We believe that the local prognosis usually is excellent if a subtotal thyroidectomy is done in the chronic type of tuberculosis before the stage of massive infiltration. Nather [26] states in relation to the relative frequency of miliary tuberculosis in the thyroid gland that the progressive extensive degenerative changes in the glands are rare and concludes that the thyroid is apparently poor soil for tuberculosis. We believe that miliary tuberculosis in the thyroid does not usually progress and will respond favorably to general anti-tuberculous therapy unless the miliary tuberculosis is part of an overwhelming general infection.

SUMMARY OF CASE REPORTS IN THE LITERATURE

Lebert, 1862, 21.—Woman, aged twenty-five, who had died of miliary tuberculosis. Thyroid contained many tubercles.

Virchow, 1865, 44.—Reported two autopsies of acute miliary tuberculosis with miliary tubercles in the thyroid gland, which was not enlarged.

CORNIL and RANVIER, 1870, 11.—A case of miliary tuberculosis of the thyroid with generalized miliary tuberculosis elsewhere.

COHNHEIM, 1867, 9.—Eight cases of miliary tuberculosis in which there were found miliary tubercles in the thyroid gland.

CHIARI, 1878, 7.—Reported 100 autopsies of acute and chronic tuberculosis. With careful scrutiny of the thyroid gland, he found among them 7 cases with thyroid tuberculosis; in 4 cases of acute tuberculosis 3 thyroids were involved; in 96 cases of chronic tuberculosis 4 thyroids were involved.

WEIGERT, 1882, 47.—States that in acute miliary tuberculosis the thyroid gland is quite uniformly involved, and he described 13 cases in which miliary tubercles were found.

FRAENKEL, 1886, 16.—States that in acute tuberculosis the thyroid gland is never missed. He found frequent involvement of the thyroid in chronic tuberculosis. Among 50 autopsies of tuberculous cases, 6 showed tuberculosis of the thyroid gland.

J. BERRY, 1890, 4.—"A specimen of an otherwise normal thyroid gland. It was removed from the body of a patient who had died of general tuberculosis. I should not have deemed this small specimen worthy of exhibition were it not for the fact that I have not been able to find a specimen of tubercle of the thyroid in any of the twelve London Museums that I have searched . . ."

WOLFLER, 1883, 48.—States that he had seen several cases of miliary tuberculosis of the thyroid, but had not observed chronic tuberculosis.

HEGAR, 1891, 19.—Reviews the protocols of 8187 cases at the Pathological Institute at Kiel, in 37 years preceding 1891 and of the 1563 tuberculous autopsies, 57 cases showed involvement of the thyroid in the tuberculous process. Of these cases 52 were of the miliary type and 5 of chronic tuberculosis. Unfortunately, in the latter cases there is missing microscopic examination.

VOELCKER, 1890, 45.—"From 3 cases of general tuberculosis in children, in each the presence of miliary tubercles was shown by microscopic examination."

PERRY, 1890, 28.—A girl of ten years, who had died of tuberculous meningitis, was found at autopsy to have enlarged bronchial glands and a miliary tuberculosis in the thyroid.

VIRCHOW, 1865, 44.—Reports the autopsy of a man in which he found tuberculosis of the lymph-glands of the neck, a purulent parotitis and caseous nodes in the thyroid, soft in consistency and bordering on the lymph-glands.

WEIGERT, 1882, 47.—A case of generalized miliary tuberculosis with a particularly high grade tuberculosis of the left lobe with large caseous masses. In one vein there were two very distinct tuberculous nodes in the wall.

CHIARI, 1878, 7.—1. A man of forty-nine years. Chronic tuberculosis of the lung, trachea and lymph-glands of the neck. Left half of the isthmus contained a hazelnut-size caseous infiltration. Miliary tubercles elsewhere in the gland.

2. A man of twenty-nine years. Chronic pulmonary and laryngeal tuberculosis. Tuberculosis of the lymph-glands of the neck. Pea-sized tuberculous infiltration plus miliary tubercles.

3. A man of sixteen years. Chronic tuberculosis of the lung, lymph-glands of the neck and intestine. Thyroid small. No colloid. Left lobe contained hazelnut-sized caseation.

4. A man of twenty-five years. Chronic tuberculosis of lungs, larynx, lymph-glands of the neck and intestine. Both lobes of the thyroid show chronic tuberculosis.

DEMME, 1878, 14.—A girl of five months, with pulmonary tuberculosis, showed a follicular thyroid with numerous pea-sized tuberculous nodes. Enlargement of the lymph-glands of the neck.

BRUNS, 1893, 5.—A woman, aged forty-one. Goitre since childhood. Six months prior to examination gland rapidly became much firmer; developed pain in the goitre and tracheal compression. Palpable cervical lymph-nodes. No evidence of pulmonary

tuberculosis. Thyroid gland showed nodular caseous tuberculous nodes after hemithyroidectomy. Recurrent nerve paralysis before operation.

SCHWARTZ, 1894, 37.—A man, aged thirty. The thyroid suggesting malignancy, enlarged in a few weeks and caused unilateral paralysis of the vocal cords. Pain on deglutition. At operation it was found to contain cold abscesses with tuberculous granulation tissue. Incision and drainage.

ROLLESTON, 1897, 34.—A man of twenty-three years. Autopsy showed caseous masses of tuberculosis in the thyroid with an abscess in the left lobe, which had opened into the œsophagus with two fistulæ. Involvement glands of neck.

ROGER and GARNIER, 1900, 33.—In 5 cases of acute miliary tuberculosis the thyroid was involved only once. In 11 cases of chronic tuberculosis the gland was not involved. In one case where miliary tuberculosis followed chronic tuberculosis of the lung and pharynx the thyroid was involved with a tuberculous abscess and gray granulation tissue.

PETERSON, 1901, 29.—Chronic caseous tuberculosis of the thyroid gland was seen *in vivo*. Many visceral complications.

CLAIRMONT, 1902, 8.—An infant of two years. In three weeks developed a tumor in the neck causing marked symptoms of tracheal compression. It gave the sensation of fluctuation. The tracheal compression required immediate intervention. Incision and curettage. Persistent sinus. Recurrence. Later hypothyroidism.

PUPOVAC, 1903, 31.—A woman of forty-two years. Patient had a pulmonary tuberculosis and two walnut-sized cystic nodules in the thyroid gland. Pus obtained by exploratory puncture. Cold abscess found.

CORNER, 1904, 10.—A girl of nine years. Cold abscess in the thyroid gland. Patient died shortly after of general miliary tuberculosis.

LEDIARD, 1906, 22.—A man of twenty-one years. A moderate cystic enlargement of the left lobe. Microscopic examination—extensive tuberculosis. No discernable source of tuberculosis.

BARTH, 1884, 3.—A case of extensive caseous thyroiditis which developed rapidly and produced tracheal compression and death by asphyxia.

VON SCHILLER, 1908, 46.—A man of seventeen years. Chronic pulmonary tuberculosis; an abscess developed in the left thyroid lobe almost as large as a fist and produced dyspnœa. The cold abscess contained 90 gm. of pus with tubercle bacilli.

Ruppaner, 1908, 35.—1. A woman of thirty years. Family history of goitre and tuberculosis. No previous history of goitre. Large nodular, elastic goitre slightly painful, developed rapidly in three months. Hemithyroidectomy in two stages.

2. A woman of twenty-eight years. Scrofula as a child. Goitre since childhood. During pregnancy goitre enlarged, causing marked dyspnœa and requiring intervention on the third puperal day. Caseous tuberculosis in an adenomatous goitre.

3. A woman of fifty years. Family history of goitre. Goitre since childhood. Cyst of thyroid incised at age of twenty-three. At age of forty-two symptoms of Basedow's disease. Hard nodular mass in the neck, no evidence of tuberculosis. Sub-total thyroidectomy. Adenomatous goitre with Basedow signs plus caseating tuberculosis.

LENORMANT, 1908, 23.—A man of forty years. A soft fluctuant walnut-sized tumor in the thyroid region. A cold abscess over the right trochanter. Chronic caseating tuberculosis with abscess in the thyroid. Curretted and drained.

HALSTEAD, 1910, 17.—A woman of twenty-eight years. Swelling in the thyroid region with pain, dyspnœa and dysphagia for one month. Ruptured spontaneously. Removal of remaining thyroid tissue. Caseous tuberculosis with large abscess cavity.

CREITE, 1912, 13.—1. Woman of forty-three years. Developed mass size of hen's egg, painful on palpation, in thyroid. No evidence of tuberculosis clinically. Partial thyroidectomy. Numerous large tubercles found.

2. A woman of fifty-eight years. Nodule in the thyroid for several years, became

much larger in several weeks and caused pain, dyspnœa and dysphagia. Apple-sized mass of tuberculous granulation tissue without caseation.

POLLAG, 1913, 30.—1. A woman of fifty-eight years. Goitre since childhood. Right lobe enlarged gradually with pain and dysphagia in one year. Adenomatous goitre with caseating tuberculosis.

2. A woman of fifty-nine years. Family history of tuberculosis. Past history suggestive of tuberculosis; goitre since childhood. Tuberculosis of the knee with thigh amputation. Following this tuberculous abscess with caseation developed in the thyroid. Incised—pus contained tubercle bacilli.

3. A woman of seventy-four years. No history of goitre or tuberculosis. Suddenly noted marked enlargement of right thyroid lobe. Painless, bluish-red in color. Pressure symptoms. Fluctuant. Cold abscess.

HEDINGER, 1912, 18.—In five years examined 659 thyroids, of which 10 showed tuberculous changes (3 cases reported by Ruppaner).

CAMERA, 1912, 6.—A woman of fifty-one years. Fist sized, wooden hard consistency, adherent tumor of the thyroid, developed in six months. Excision impossible due to massive infiltration; operative death. Adenomatous goitre with tuberculous granulation tissue and caseous degeneration.

TIXIER and SAVY, 40.—A woman of forty-six years. A very hard and diffuse enlargement of the thyroid gland, accompanied by dyspnœa, appeared in a year's time. Partial excision. Dyspnœa returned in three weeks. Sudden death. No autopsy. Tuberculous granulation tissue.

ARND, 1912, 1.—A woman of fifty-three years. Past history of goitre for many years. Caseating tuberculosis found in an adenomatous goitre.

2. A man of thirty-two years. Goitre for thirteen years. Marked enlargement of the thyroid gland in six months. Enlarged glands in the neck. Colloid goitre with tuberculosis.

3. A woman of thirty-five years. Had had a goitre for years. Colloid goitre with tubercles.

SCHONBERG, 1918, 36.—A woman of forty years. An autopsy of generalized miliary tuberculosis, apparently primary in bronchial lymph-nodes; chronic caseating tuberculosis of the thyroid.

UEMARA, 1917, 43.—Examined 1400 thyroids after thyroidectomy. Twenty-four cases showed tuberculosis in adenomatous goitre. Of these there were 20 women with an average age of 32.4 years and 4 men, average 27.5 years. In all these cases, except one, the tuberculous element was of minor importance. He reported 3 cases of Basedow's disease, two of which contained miliary tubercules and the third moderate caseating tuberculosis, and 3 cases which he considered of primary tuberculosis. These are:

1. A woman of thirty-nine years with great enlargement of the thyroid, apparently following influenza—tuberculous granulation tissue.

2. A man of forty-six. Thigh amputation short time previously for tuberculosis of bone. In three weeks acute swelling of thyroid gland with extreme dyspnœa requiring tracheotomy.

3. A woman of forty-three years. Goitre for a long time. Treated with iodine. Moderate ceaseating tuberculosis.

MOSIMAN, 1917, 25.—1. A man of twenty-three years. Symptoms of hyperthyroidism eleven months. Followed in a few months with increase in size of the neck. Moderate hyperplasia, tuberculosis, and lymphoid tissue; definitely isolated, conglomerate tubercles in a portion of the gland.

2. A woman of twenty-nine years. Past history of pleurisy. Signs of hyperthyroidism for one year. Colloid goitre with calcified adenoma and tuberculosis; tubercles in one section in many fields.

3. A woman of eighteen years. Two months signs of hyperthyroidism and slight swelling of the neck. Hyperplasia plus tuberculosis; diffusely scattered tubercles in all the sections.

4. A woman of sixty years. Hard, rapidly growing swelling of the thyroid gland in eight weeks. Sarcoma plus tuberculosis; scattered tubercles.

5. A woman of twenty-five years. Signs of exophthalmic goitre one year. Hyperplasia and tuberculosis; encapsulated minute tubercles densely packed together and separated by compressed thyroid follicles.

6. A woman of twenty-four years. Signs of hyperthyroidism seven years. Hyperplasia and miliary tubercles.

7. A woman of thirty-eight years. Hyperthyroidism for nine months. Microscopically an adenomatous goitre with considerable tuberculosis.

8. A woman of forty-seven years. Clinical diagnosis; hypertonus. Colloid goitre with tuberculosis; conglomeration of tubercles in two small nodules.

9. A woman of thirty-two years. Signs of hyperthyroidism in four months. Hyperplasia with adenoma and tuberculosis; conglomerate masses of tubercles with slight necrosis in a few sections.

PLUMMER and BRODERS, 1920, 27.—Report 7 operated cases. 1. General symptoms for four years. B. M. R. plus 48 per cent. Pathological examination: Scattered areas of tuberculosis and extensive parenchymatous hypertrophy.

2. General symptoms for ten months. B. M. R. plus 87 per cent. Pathological examination as in Case I.

3. General symptoms for two years. B. M. R. plus 26 per cent. Pathological examination—extensive tuberculosis, slight parenchymatous hypertrophy in a fair degree.

4. General symptoms for one year. B. M. R. plus 21 per cent. Pathological examination—extensive tuberculosis. Slight parenchymatous hypertrophy and great destruction of the gland.

5. General symptoms for one year. Thyroid three times normal size, hard and slightly nodular. Pathological examination—as in Case IV.

6. General symptoms for two years. A very hard tumor in the left lobe. Pathological examination—tuberculous destruction as in Case IV, but more parenchymatous hypertrophy.

7. Enlargement of the thyroid gland for one month. At operation a small, hard tumor pressing on the trachea was found. Pathological findings—as in Case IV, except no parenchymatous hypertrophy.

RENDLEMAN and MARKER, 1921, 32.—A woman of twenty-two years, who had had a discharging sinus in the neck in earlier life, had gradual thyroid enlargement with slight dysphagia for ten months. B. M. R. minus 18 per cent. Pathological diagnosis: Diffuse non-caseating tuberculosis of the thyroid. Myxœdema developed after a sub-total thyroidectomy.

AUBRIOT, 1925, 2.—A woman of fifty-two years. Walnut-sized, painless thyroid tumor ten years. Development of hen's egg-sized semi-hard, slightly movable mass in thyroid in several months. Painful. Dyspnœa at night. Palpable cervical lymph-glands. Signs at left pulmonary apex. Sub-total thyroidectomy. Uneventful recovery. Tuberculous granulation tissue without caseation.

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SHOULD THE GALL-BLADDER BE REMOVED WITHOUT DRAINAGE?

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As illustrative of the conclusions presented in the following paper, a case record is herewith submitted: a woman, fifty years of age, was subjected to operation at the Hospital of the University of Minnesota, January 18, 1926, with a diagnosis of chronic gall-bladder disease. The gall-bladder was exposed January 20 through a six inch mid-rectus incision. The gall-bladder was removed with facility. The operative procedure was unusually easy and there was no oozing or trauma to the liver. Feeling that the case was well suited for the omission of drainage, I closed the incision without the insertion of any drain. The gall-bladder was removed by the subserous method and the stump of the cystic duct was buried in the split hepatoduodenal ligament.

The convalescence of the patient was smooth and uneventful till the evening of January 26, 1926, at which time slight icterus was noted in the sclera. On the morning of January 27, 1926, the patient looked and felt well. During the day, she complained of occasional pain through the right upper abdomen. At 5 P.M., severe generalized abdominal pain had developed. The abdomen had become quite distended, and universally tender, but without marked rigidity. At 8:30 P.M. the patient's condition was alarming. She was evidently in marked shock. The pulse was irregular and rapid, the radial rate averaging 160 beats per minute. The respirations were shallow and rapid; the patient's skin was moist with a cold clammy sweat. The blood pressure was 85 systolic and 62 diastolic. A provisional diagnosis of leakage of bile * from the stump of the cystic duct was made. Operation, however, was out of the question. Because of the irregular heart action, transfusion was deemed unwise. Morphine gm. 010 was given subcutaneously and hypodermoclysis of normal salt solution was started. Six c.c. of digitan and 2 c.c. of pituitrin were given hypodermically during the night. Thirty-five hundred c.c. of .9 per cent. NaCl was taken.

The next morning the patient's condition was somewhat improved. She had recovered from shock, but the pulse was still weak and irregular, about 130 in rate. The temperature was 99.6 F., and respirations were 28 per minute. The abdomen was moderately distended and dull to percussion in both flanks. The patient did not complain of much pain. On January 29, 1926, a very definite jaundice was present and the urine showed considerable bile pigments present, as well as many granular casts and an occasional white blood cell. The patient's condition was much the same. Vomiting occurred from time to time. On January 30, 1926, when the dressings were changed, a discharge of bile was noted from the wound. The edges were spread with forceps and about 1500 c.c. (estimated) of bile colored fluid gushed forth.

The stools at this time were acholic. A rather free drainage of bile from the

* This picture was due to the absorption of the toxic bile salts. Cultures of the bile in the gall-bladder were made at operation and were negative for bacteria. No calculi were present in the gall-bladder, but the wall was thickened and microscopically definite evidence of a chronic cholecystitis was present. The bile of most diseased gall-bladders contains bacteria, though they are often difficult of demonstration, and on animal innoculation have a very low virulence. For all practical purposes, such bile may be considered sterile. The effect of its escape into the peritoneal space and that from an acutely inflamed gall-bladder differ markedly. This phase of the problem has been dealt with in detail by the author in another paper of this journal.[66]

incision occurred continuously, necessitating frequent changes of the dressings. Following this escape of bile, the patient felt and appeared much better. The pulse again became regular. A few days later, however, the patient complained of increasing weakness, inability to eat, and appeared listless. Beginning on February 7, 1926, the bile escaping through the incision was collected in a bottle and given to the patient by stomach tube for 5 days, but without much improvement.

On February 12, 1926, the patient was able to sit up on a chair, and from then on the improvement was rapid. On February 20, 1926, bile could easily be demonstrated in the feces, and the leakage through the incision was almost negligible. She ate well and felt much stronger. On March 13, 1926, the patient was discharged well.

The advocates of dispensing with drainage after cholecystectomy have in mind naturally the advantages which accompany its omission, *viz.*: (1) Diminution of adhesions. (2) More rapid healing and a shorter convalescence. (3) Lesser danger of hernia. The chief deterrents to the general adoption of the method have been the danger to life through the escape of bile, hemorrhage, and infection.

That the danger of bile leakage is real following cholecystectomy, however, there can be no doubt. Finsterer,[19] Haberer [27] and Heidenhain [30] have each observed instances following intentional or inadvertent early removal of drains in which bile escaped into the peritoneal cavity and caused the death of the patient. Walzel [65] reports three cases that died of bile peritonitis in which drainage was employed. In two the peritonitis was diffuse, in the other local. The cystic duct was well occluded. Whether death was due to inadequate or too early removal of the drains is not stated. Holman [39] says: "Several unfortunate experiences have been called to my attention in which patients died following cholecystectomy with symptoms of peritonitis. At necropsy the abdomen was found filled with bile and the cystic duct was wide open." No mention is made whether drainage was employed. Haberer [26] who practices peritonealization of the cystic duct stump has had occasion, himself, to reopen the abdomen 36 hours later because of biliary leakage when drainage was omitted. The cystic duct was intact; the leakage occurred from a small aberrant bile duct. Laewen, according to Burckhardt,[11] has had the same experience. Fortunately these patients recovered. Similar instances in which the patients recovered have been recorded by Schulz,[61] Vorschütz,[64] and Hilgenberg.[33] Orth [53] reports the successful outcome after relaparotomy in another instance following cholecystectomy in which drainage was omitted. The ligature on the cystic duct, Orth states, had slipped off. Marquardt [47] and Naegeli [52] each report two instances in which omission of drainage necessitated laparotomy because of leakage from the cystic duct.

Unfortunately, the outcome is not always so favorable. Beer [1] states that one of his assistants saw three such fatal cases in Berlin some fifteen years ago, in which at autopsy on the day following operation bile was found in the free peritoneal cavity. Witzel [70] states in a letter to Kehr that he had done 500 cholecystectomies in which drainage was omitted with only one mortality, but death in this instance was due to the escape of bile into the peritoneal space. Kocher,[45] Heidenhain,[30] Franke,[21] Grekoff,[24] Walzel,[65]

Martin,[48] Hollenbach,[38] and Morian,[50] report similar occurrences in which the outcome was lethal due to the escape of bile when drainage was omitted. Enderlen [18] says that he knows of five such cases operated on by Swiss surgeons, and Finsterer [20] states that several similar instances not reported have occurred in Vienna. Scheele [60] states that three other such fatalities are known to Heidenhain. Dr. A. C. Strachauer [63] has told me of a like occurrence in his own practice, in which relaparotomy failed to save the patient's life. Dr. S. Marx White [67] informs me that he has seen three such instances in consultation, all of which were fatal.

It has probably been the experience of most surgeons that bile occasionally appears on the dressings following cholecystectomy when drainage is employed. Blalock [4] states that in a series of cases in which cholecystectomy was performed at the Johns Hopkins Hospital by different operators, that bile drainage was noted in 38 per cent. Cignozzi [12] states that despite double ligature of the cystic duct some bile leakage occurs in about 30 per cent. of cholecystectomies. Undoubtedly these figures are higher than the experience of most men would indicate. It has even been suggested that this escape of bile is due to the drain itself, but in the light of the instances reported where no drainage was employed, this intimation is without significance.

There are three causes operating that can adequately account for the leakage of bile following simple cholecystectomy, barring technical errors and injury to the normal bile ducts. When bile appears on the dressings soon after cholecystectomy, its cause may be sought in the severance of small anomalous ducts not recognized at operation of the character recently described by Holman [39] and Hotz,[40] or to trauma to the liver bed and oozing of bile from small bile canaliculi. The bile that escapes seven to eight days, or longer, after simple cholecystectomy is in all likelihood due to an insufficient occlusion of the cystic duct. The escape of bile that occurred in my patient was probably due to this cause. The suggestion that this leakage of bile is due to the drainage employed, the drain in some manner loosening or displacing the ligature on the cystic duct, is not tenable. Likewise, the pressure of the bile flow in the common bile duct is inadequate to account for the leakage from the cystic duct. The more likely cause for the insufficiency of the cystic duct after ligation, I believe, lies in the explanation that the ligature cuts through the cystic duct; necrosis of the duct occurs and in consequence thereof bile escapes. Occlusion of the cystic duct by a ligature is not to be compared with that of an artery. In the latter, death of the arterial wall is brought about by pressure or by the ligature cutting through the arterial wall. Hemorrhage does not obtain, because even though intimal [28] union may not occur, a quick organization of the protecting thrombus and the necrotic arterial wall takes place. In the case of the cystic duct, however, there is no such protective mechanism to guard against the leakage of bile while the necrotic wall of the bile duct is being repaired. Similar escape of urine from a divided ureter is occasionally observed after ligation.[41, 8]

Buchbinder [10] and Holman [39] have failed to observe leakage of bile from

the cystic duct in the dog when the gall-bladder is removed without drainage. But Holman's observation, that in seven of twelve dogs in which he ligated the cystic duct with two silk ligatures one centimetre apart, that small cysts were found located between the two silk ligatures, throws considerable light on the process of repair in a severed bile duct. It would also tend to show that too many ligatures do not insure safety but on the contrary make the danger of the escape of bile more actual because of the greater necrosis in the duct wall.

In consequence of the anxiety to close the abdominal wall without drainage, and in recognition of the inadequate protection against bile leakage even when the gall-bladder fossa and cystic stump are covered by the leaves of the hepatoduodenal fold, a number of novel methods have been suggested for treating the treacherous cystic duct stump. Doberer [17] recommends amputation of the cystic duct high up and implantation of the distal end into the lumen of the duodenum. Hofmeister [37] has buried the distal portion of the cystic duct in the duodenal wall. Stettin [62] fashions a peritoneal flap to cover the stump of the cystic duct. Burckhardt [11] and Plenz [55] bury it in the freed round ligament. Hilgenberg [33] buries the distal end of the duct behind the posterior parietal peritoneum. Rotter [59] and Goldman [23] have recommended folding the cystic duct on itself and tying the duct twice before suturing the hepatoduodenal ligament over it. Hoffman [34, 35, 36] ties the cystic duct itself in an autoplastic knot by freeing it from the adjacent tissue until a single knot can be tied on the duct with the aid of an instrument. He prefers, however, to leave a drain down to the remaining portion of the duct. C. H. Mayo [49] has practiced the method of leaving a few strands of catgut to project down through the wound to the end of the duct.

No one would argue that the employment of drainage has not certain disadvantages. But in view of the inadequacy and risk of its omission, the practice of employing drainage is peremptory. The aversion to its use in cholecystectomy that has arisen out of the adhesion stimulating property of drainage is not well founded. The choice of a drain is naturally of great importance. The employment of tamponade in the form of a gauze pack or the use of hard rubber tubes is superfluous. A gutta percha tissue drain (Penrose drain) inserted down to the stump of the cystic duct is adequate. If then, this drain is led out through a stab wound lateral to the incision, the delayed healing of the wound and danger of hernia is probably no greater than if the wound is closed with the omission of drainage.

It has probably come within the experience of every surgeon to open an abdomen, the seat of a fairly diffuse peritonitis, and to find subsequently when the abdomen is reopened at a later date, that no signs of a previous inflammation exist. And again it has probably been most everyone's lot to find difficulty in even entering the peritoneal cavity after a previous clean procedure done with a minimum of trauma. No doubt there must exist an individual factor in the formation of adhesions. Certainly the employment

of a gutta percha drain is less conducive to adhesion building than is the trauma of the operative procedure, no matter how carefully done.

Schulz,[61] Blezinger[5] and Hofmeister[37] have each had to reopen the abdomen after cholecystectomy when drainage was omitted because of a hæmatoma that formed in the fossa beneath the liver. Is it not possible that with the exhibition of a drain that can give vent to the secretions that may collect in the gall-bladder bed, that adhesion formation may be even less likely than when drainage is omitted? Harttung[29] and Kehr[44] have both had occasion to reoperate when the gall-bladder had been removed without drainage and found extensive adhesions in the upper right quadrant of the abdomen. They express themselves in favor of such an opinion. Yates[71] in advocating drainage frankly states that "The amount of peritoneal irritation will be lessened by the use of a drain." The too early removal of the drain is also to be deprecated. Some employ drainage for only 24 to 72 hours. This type of drainage would take care of leakage from an unrecognized anomalous duct or injury to the liver bed, but would be of no avail should later the cystic duct ligature prove insufficient. A number of fatal instances from such a cause have been enumerated above. Kehr[44] states that the drain should be left in about twelve to fourteen days. When Haberer[27] thinks drainage indicated this has also been his practice. At the University Hospital, the custom has been to leave the drain undisturbed for about eight days, then within the next three or four days to remove it gradually.

Certainly the omission of drainage following cholecystectomy is a hazardous procedure. Haberer[27] states that he is glad to see his assistants employ drainage when the gall-bladder is removed. Moynihan[51] says: "I never close the abdomen without a drain, though in the days of my adventurous youth I often did so." Crile[15] believes the employment of adequate drainage to be of paramount importance in cholecystectomy. Kehr states that he has had occasion to change his mind about many things in gall-bladder surgery, but has never yet had the courage to close the abdomen without drainage following cholecystectomy. Enderlen says that "in the fear of God and the peritoneum," he is wedded to its use. Enderlen credits Deaver[16] with the statement that he who removes the gall-bladder without drainage, "would fill our cemeteries with gravestones with this inscription: 'Died following cholecystectomy without drainage.'"

SUMMARY

The so-called "ideal cholecystectomy" is not a safe procedure. An instance of its practice in which drainage was omitted is cited, the outcome of which was favorable following the spontaneous escape of a large quantity of bile through the abdominal incision. Numerous instances are reported where relaparotomy was necessary because of bile leakage when drainage was omitted. A still greater number died because of the escape of bile and the failure to drain. The leakage of bile may be early or delayed. That occurring soon after removal of the gall-bladder is due to injury to the

liver bed or severance of small aberrant bile ducts. The delayed escape of bile is occasioned by insufficiency of the cystic duct occlusion. Drainage after cholecystectomy is imperative. It is a safeguard and does no harm.

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AN ANALYSIS OF FOUR HUNDRED AND EIGHTY-TWO GALL-BLADDER CASES

TREATED IN THE FIRST SURGICAL DIVISION OF THE NEW YORK HOSPITAL

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AND

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Any analysis of a group of cases must necessarily present a mass of figures more or less statistical. It is not the intention of this paper to try to prove anything by these statistics. The cases represent the ordinary run of patients who present themselves for treatment in a metropolitan hospital of the type of the New York Hospital, and represent a varying racial type as well as a great variety of pathological conditions in the gall-bladder.

Our follow-up system instituted by Gibson began in 1913, but was not in complete working order until 1914, and the cases used for the basis of this paper are those from 1914 to 1924 inclusive.

The principal procedure in treating gall-bladder disease on the First Surgical Division has been cholecystectomy when that procedure has been advisable. In a very small group of cases this has been the so-called "ideal cholecystectomy" with peritonealization of the gall-bladder area and the closure of the abdomen without drainage. In case of any doubt in the operator's mind, drainage has been instituted.

In the cases not suitable for cholecystectomy, that is, in cases which were too seriously ill, or whose general or local condition did not warrant the more radical procedure of cholecystectomy, and in those cases with marked pancreatic changes which required prolonged drainage, cholecystostomy was the method of choice. This was later followed by cholecystectomy, if the result thus obtained was not satisfactory.

The choice of the operation must be left to the operator and made to fit the case, and in so far as it is possible to say such was the procedure in the list of the cases here reported. The major portion of the cases were operated upon by the senior members of the staff with a scattering number of cases among the junior members and the result represents, we believe, a very fair presentation of the outcome of surgical procedure for biliary disease in the hands of a competent surgical staff, with its material derived from the ordinary ward cases in a city hospital.

In the follow-up certain terms are used to express the result. A case is classified as excellent when the patient is relieved of all symptoms, has no complaints, and in which the result of the post-operative examination shows a practically perfect result from the operation.

The term satisfactory is applied to those cases in which there is some minor complaint or some finding in the examination which does not place

the patient in the excellent class, but in which the result is, from the surgical standpoint, considered a satisfactory one.

The cases are classed as unsatisfactory chiefly from the story given by the patient of his condition following the operation. Many of the cases so classified have little on physical and X-ray examination to justify many of the complaints which these patients have, but it has been our feeling that some distinction had to be made and in the long run we could strike a better average by keeping to the above three classes rather than by making a more elaborate classification. After all, the patient must be considered and his complaints are an index of the benefit derived from the treatment.

Our death rate may seem high, but if the deaths are analyzed, it will be evident that the outcome could not be improved, considering the character of the case in question and the condition of the patient at the time he entered the hospital.

During the period given below, 482 cases of gall-bladder disease have been submitted to surgical treatment. Of these 482 cases, 400 cases were submitted to cholecystectomy and 82 to cholecystostomy.

Results

	Cholecystectomy	Cholecystostomy
Excellent	203—50.75%	32—39.02%
Satisfactory	112—28%	20—24.39%
Unsatisfactory	30— 7.50%	13—15.85%
Dead	39— 9.75%	13—15.85%
	(29—7.2%)	(8—9.7%)
Not found	16—4%	4— 4.87%
	400—100%	82—99.98%

From the above, 78.75 per cent. of the cases of cholecystectomy have given a satisfactory surgical result, that is, the patient has been cured. Sixty-three and forty-one hundredths per cent. of the cholecystostomy cases also come under the same category. There is a higher group of unsatisfactory cases in the cholecystostomies, and as would be expected a higher mortality, because that procedure was used in the poorer surgical risks.

In analyzing the deaths in the list of cholecystectomies, two of the cases died at home before the three-month period after leaving the hospital, of conditions not known but which the family stated had come from the operation.

Of the 37 cases which died in the hospital:

3 died of carcinoma of the gall-bladder.
5 died of shock.
7 died of peritonitis.
1 died of cause not known.
6 died of pneumonia and broncho-pneumonia.
2 died of pulmonary embolism.
1 died of carcinoma of the stomach.
1 died of acute nephritis.
1 died of acute pancreatitis.

2 died of acute cardiac failure.
1 died of stenosis of common duct.
1 died of septicæmia.
1 died of high temperature—cirrhosis of the liver.
1 died of acute psychosis.
1 died of hemorrhage.
1 died of constant hiccough.
1 died of myocarditis.
1 died after secondary operation in which echinococcus cyst of liver was found.

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In the deaths, peritonitis 7, shock 5, and pneumonia 6, occupy the leading positions. Three of the cases which died of shock had choledochotomy for common duct stone. If the cases such as those with carcinoma of the stomach, carcinoma of the gall-bladder, acute pancreatitis, cirrhosis of the liver, echinococcus cyst, and the cases with choledochotomy are eliminated the mortality for cholecystectomy will be reduced by ten cases, leaving a total from cholecystectomy of 7.2 per cent.

Of the cases submitted to cholecystostomy, 13, or 15.85 per cent., died.

3 died of carcinoma of the gall-bladder.
1 died of secondary operation for echinococcus cyst of the liver.
1 died of acute pancreatitis.
2 died of shock.
1 died of pulmonary embolism.
1 died of cardiac failure.
1 died of asthenia.
1 died of chronic pancreatitis.
1 died of lobar pneumonia.
1 died of general peritonitis.

13

Three cases classed as unsatisfactory died after leaving the hospital, one of carcinoma of the liver, one of carcinoma of the lung and one of carcinoma of the stomach.

Here again many of the conditions for which the operation was undertaken might well be removed from the list of fatalities of cholecystostomy.

Thirty-five cases had choledochotomy for common duct stone with three deaths—9 per cent. with 28 excellent results. Four cases were unsatisfactory and required secondary operations, three for stenosis of the duct and one for persistent biliary fistula.

In the cases in which gall-stones were present in the gall-bladder, the result of the follow-up showed a higher percentage of excellent results than was true when cholecystitis alone was present.

	Per cent.
Gall-stones, excellent	48
Cholecystitis, excellent	41
Gall-stones, unsatisfactory	5.7
Cholecystitis, unsatisfactory	9.9

The cases with carcinoma of the gall-bladder and duct all died.

The age incidence of the onset of gall-bladder symptoms is also interesting in that more than half the cases had symptoms of gall-bladder disease before the fortieth year, and in many of the cases over forty, the history gave digestive disturbances for many years before the onset of symptoms sufficiently definite to cause the patients to seek medical advice. That is our cases show an earlier age incidence than that given for gall-bladder disease. The youngest case had symptoms at the eighth year, and was operated upon when a little over ten years of age and a large stone removed with a pathological gall-bladder.

The intercurrent diseases or conditions found and treated were:

Fibromyomata of the uterus	33 cases
Salpingitis, chronic	9 cases
Salpingitis, acute	1 case
Appendicitis, chronic	105 cases
Appendicitis, acute	1 case
Abscess, pelvic	1 case
Abscess, tubo ovarian	1 case
Oophoritis	1 case
Endocervicitis	1 case
Endometritis	1 case
Pregnancy, tubal	4 cases
Hernia, umbilical	6 cases
Hernia, inguinal	2 cases
Ovarian cyst	7 cases
Retroversion and retroflexion of uterus	6 cases
Intraligamentous cyst	3 cases
Non-rotated cæcum	1 case
Pancreatitis, chronic	26 cases
Pancreatitis, acute	1 case
Ventral hernia	2 cases
Harris band	8 cases
Diverticulum of the duodenum	1 case
Duodenal fistula	1 case
Cirrhosis of liver	2 cases
Interstitial hepatitis	2 cases
Lipoma	2 cases
Cervical polyp	1 case
Carcinoma of stomach	1 case
Perforated ulcer of duodenum	3 cases
Pyloric stenosis	2 cases
Splenomegaly	2 cases
Jackson's membrane	4 cases
Myosarcoma	1 case
Riedel's lobe of liver	1 case
Echinococcus cyst of liver	1 case
Angioma of ileum	1 case

CANCER OF THE SIGMOID AND RECTUM IN CHILDREN AND YOUNG ADULTS

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Malignant epithelial growths of the sigmoid and rectum are not unknown in children and adolescents, as a glance through the literature will show. To date there have been reported 51 cases of carcinoma in this location under twenty years of age. To these may be added the following case:

H. L., male, aged sixteen, entered the Samaritan Hospital, March 8, 1924, complaining of pain in the sacroiliac region and lower abdomen. This was first noticed about six months previously, but has since become worse.

Past History.—Three years ago patient was operated upon for an inguinal hernia. During the summer of 1923 he suffered from bleeding hemorrhoids (patient's diagnosis). He again underwent an operation for a recurrence of the hernia in November, 1923. Since then the pain has been more severe.

Physical examination revealed a somewhat emaciated young man of pallid appearance. The chest was negative. There was no tenderness, rigidity or distention of the abdomen. Along the course of the descending colon, enlarged glands could be palpated. Examination by the neurologic, röntgenologic and urologic services revealed nothing locally to account for the pain. Urinalysis and Wassermann reaction were negative. Blood count showed: Hæmoglobin, 35 per cent. (Dare); red blood cells, 2,360,000; white blood cells, 6400; polymorphonuclears, 67 per cent.; lymphocytes, 30 per cent.; mononuclears, 3 per cent. Coagulation time by the Boggs-Brodie method was four and a half minutes. Stool was strongly positive for occult blood. Proctologic examination by Dr. H. Z. Hibshman on March 10, 1924, showed that on the posterior part of anus, there was evidence of an old infection, now healed. No new growths found. The descending feces were dark in color and contained mucus. The odor suggested malignancy, which was thought to be the cause of the bleeding rather than tuberculosis. Palpation indicated a nodular condition along the pelvic and descending colon. Pre-operative diagnosis—Tabes Mesenterica.

The abdomen was opened by Dr. W. W. Babcock on March 12, 1924, with the following pertinent findings: There was a mass of calcified and degenerated glands, the size of a fist, at the brim of the pelvis; also an annular constriction of the sigmoid at the level of the pelvic brim, adherent to a loop of ileum. Colostomy was performed and a small piece of indurated tissue removed for examination. Following the operation the patient gradually weakened and died three days later from asthenia on March 15, 1924. Permission for necropsy was denied.

Pathological Report.—Specimen consists of small bits of tissue, some having a covering of mucous membrane about 1 mm. in thickness, overlying a rather dense layer, composed of bands of translucent and opaque firm tissue, about 0.5 cm. in thickness. There are also small spherical bodies composed of tough outer capsules and chalky centres. Microscopic section shows a mucous membrane with a hypertrophic and catarrhal epithelium infiltrated with polymorphonuclear leucocytes. In places the normal basal location of the nuclei is disturbed. As the muscularis mucosa is approached in these areas, the epithelial cells change from columnar to spherical in type with open vesicular nuclei and distinct nucleoli, and the regular tubular gland formation is lost (Fig. 1). In these same areas there is a penetration of the submucosa by the epithelial cells, where they lie in solid strands and masses and imperfectly hollowed out glandular acini (Fig. 2).

These nests of epithelial cells form a distinct mass, quite completely filling the submucosa in one area and beginning to infiltrate the muscular coats. They also show some polymorphonuclear cellular infiltration. The extra-muscular tissue shows only perivascular round cell infiltration. The small spherical bodies show a hyalinized connective tissue capsule, with practically no cellular elements and a central amorphous hematoxylin staining mass. Diagnosis.—Carcinoma Sigmoid. Calcified tuberculous lymph-glands.

Incidence.—In 1865 Steiner [1] quoted Henning as having found only 12 cases of carcinoma in 1,000,000 living children under fifteen years of age; 6 between the ages of five and ten years and a like number between ten and fifteen years. Weinlechaer [2] reported 18 cases of carcinoma in children under fourteen years of age, in a series of 5279 cases. Feldner,[3] however, in 914 cases of carcinoma, only encountered 3 in children up to sixteen years. Bernouille,[4] in 1907, in reviewing 50 carcinomas of the digestive tract under twenty years, found 29 in the sigmoid or rectum, many, however, were not verified microscopically. The following year, Philip [5] collected 390 cases of carcinoma in childhood, of which number he felt only 87 were genuine. The incidence in the digestive tract was 46 per cent., although the sigmoid was affected in only 5.4 per cent. In 111 cases the large bowel was involved 28 times, 7 of which were in the sigmoid. Pennington,[6] from statistics compiled in 1921, found 40 carcinomas of the rectum under twenty years in

FIG. 1.—Low power microphotograph. Note irregularity of tubular glands in upper left centre.

7174 cases of cancer of the rectum. Phifer,[7] in 1923, carefully reviewed the literature and tabulated 49 cases of carcinoma of the rectum and sigmoid under twenty years of age, the large majority of which were microscopically verified. To these he added another case. In the literature since then I have been able to find only one additional case of epithelioma of the rectum in a child three years old, reported by Lasnier,[8] in 1923, bringing the total up to 52 cases, including the one reported.

FIG. 2.—Low power microphotograph, showing nests of epithelial cells beneath muscularis mucosa.

Discussion.—Although no common etiological factor was observed in the cases reviewed, the possibility of a tuberculous ulcer offering a point of chronic irritation must be borne in mind in the case reported. The symptoms, while often indefinite and varying, depending upon the location and amount of ulceration, are nevertheless of sufficient localization to warrant careful analysis and examination. Contrary to the rule, in adult carcinomas, pain seems usually to be the earliest symptom. This may be general or referred to the lower abdomen. Painful defecation is quite common in conjunction with constipation; tenesmus on the other hand, is more frequent with diarrhœa. The former seems to be the commoner finding, not infrequently leading to absolute obstruction of the bowel, resulting in an acute surgical abdomen. This latter seems to be more frequent with carcinomas involving the sigmoid. At some stage of the disease melena almost always

occurs. This may vary from the occasional passage of small amounts of blood mixed with mucus, to a sudden sharp hemorrhage of bright red blood. In the case reported, the blood passed was ascribed to bleeding hemorrhoids. Rectal palpation occasionally furnishes positive evidence and should always be resorted to, for Pennington, in 1670 cases, found the growth 1250 times in the ampulla and 178 in the anal canal, both within reach of the examining finger, the remainder being higher up in the recto-sigmoid portion. In the present case the peculiar odor of the feces was the sole lead to the belief in the presence of a carcinoma.

The prognosis is bad and treatment offers but little help, because the diagnosis is rarely made, only eight times in the reported cases, the age of the patient generally excluding the idea of cancer, and because the disease progresses so rapidly in the young, usually not persisting more than seven or eight months after the establishment of symptoms. Quite commonly a terminal acute ileus necessitates palliative surgical measures only, for the relief of absolute obstruction. Unfortunately most cases are in a poor physical condition when and if the true diagnosis is made and are consequently poor surgical risks for extensive operative procedure. Of the 52 cases reported, the present one included, 19 were operated upon, including 2 biopsies. There were 11 operative recoveries with 5 deaths within two weeks. Three others died ten months to two years later, leaving only three actual recoveries. The operative measures preferred for cases in a fair general state are the ones usually employed in such conditions, namely, colostomy and resection of the growth and involved bowel.

Summary.—A case of carcinoma of the sigmoid in a boy sixteen years of age is reported, being the thirteenth case on record at this age and in this location and bringing the total number of recorded cases of cancer of the rectum and sigmoid under twenty years of age to 52.

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EXTERNAL FECAL FISTULÆ IN ACUTE APPENDICITIS

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During the past decade, thirty-six per cent. of the cases of acute appendicitis, admitted to the surgical wards of the Mt. Sinai Hospital, New York City, have been complicated by abscess formation or general peritonitis. This is a serious indictment of the laity in general and the profession at large. It means that drastic purgatives are still administered promiscuously for abdominal pain, and that the ice bag and watchful waiting take their ultimate toll in death. The idea that acute appendicitis is an innocuous disease should be dispelled, for a recent paper of Willis grimly calls attention to the fact that not only is it responsible for a large proportion of surgical deaths, but that the mortality has increased within the past number of years. Nor are the unpleasant complications as rare as many would believe. Recently Deaver, in a paper based on 4063 cases of acute appendicitis, reported the incidence of fecal fistula at five per cent., of which 48.5 per cent. required operative interference. Inasmuch as the operative technic employed on the surgical service at the Mt. Sinai Hospital is slightly different, it was thought that an analysis of 2841 consecutive cases of acute appendicitis, with special reference to the incidence and cause of fecal fistulæ, might prove interesting.

In this series, 33, or 1.1 per cent., developed fecal fistulæ. The pathology of this disagreeable and serious post-operative complication is quite obvious. It is usually incident to vascular thrombosis and infection of some part of the terminal ileum or cæcum resulting in a sloughing of the intestinal wall. It is most frequently seen in cases of acute gangrenous appendicitis with perforation and abscess, in which the cæcal or ileal walls are involved in the inflammatory process, but it may be due in part to poor surgical procedure. Gentleness in the handling of tissue is ever essential, but it is paramount when removing a gangrenous appendix adherent to the omentum and adjacent intestinal coils. Rough manipulation through a small, inadequate incision can only result in trauma, the added insult of which might easily destroy compromised tissue with subsequent sloughing and fistula formation. In many instances, what rough manipulation has failed to do, improper, or poorly placed drainage will accomplish. Surgery has passed the stage of taxidermy when wounds were packed with tampons of gauze. Fistulæ then occurred as often as sixteen in a hundred. The fact that the majority of fistulæ develop when the drainage is either moved or shortened emphasizes its relationship to fistulæ development and production. Improper materials used for drainage and drainage poorly placed may easily produce a pressure necrosis of an inflamed bowel wall. Unprotected gauze packings for self-evident reasons

should have a limited application in the surgery of appendicitis, and even the use of gauze partially protected as in the "cigarette drain" is debatable. Hard unyielding rubber and glass cannot be compared to the soft, pliable, pure gum black rubber tubing which not only acts as effectively and as adequately, but exerts the minimal amount of pressure on the intestinal walls. In fact it is considered good procedure to protect compromised bowel by the insertion of rubber dam between it and the tube.

Another fact of extreme importance is the treatment of the appendix stump. Two common methods are in vogue: one is the inversion or burying of the appendix stump, the other the "simple drop" method, used almost routinely at the Mt. Sinai Hospital. A purse-string suture reinforcing an appendix stump is no guarantee against an intestinal leak, in fact it may abet it, for with the strangulation of a certain amount of blood supply and the added pressure of post-operative distention conditions are ideal for tissue destruction. Not infrequently, in passing the purse-string, a cæcal blood-vessel may be inadvertently pierced forming a hæmatoma, an excellent medium for bacterial activity. More rarely an inverted infected stump results in an abscess of the cæcal wall with subsequent perforation.

The "simple drop" method, in which the ligated stump after thorough carbolization, is dropped into the free peritoneal cavity, is a fairly rapid and simple procedure. It appears crude but the low incidence of fecal fistula following its use bears witness to its efficacy.

The diagnosis of a fecal fistula rarely presents difficulties. The discharge of gas bubbles and fæces through the abdominal wound are pathognomonic. It should be borne in mind, however, that the odor and appearance of a discharge, generated by a fascial slough, may simulate this condition quite closely. The diagnosis of fistula may easily be confirmed by oral feedings of insoluble carmine crystals or charcoal in capsules and recovering this foreign material in the dressings; or, by enemata.

When once the diagnosis of a fistula has been established, every effort should be made to prevent further necrosis of the bowel wall. Drainage tubes should be shortened or removed as soon as is possible, and if this is not feasible under the circumstances, tubes of softer, and smaller calibre should be substituted. The skin about the wound should be adequately protected with a suitable ointment or paraffine dressing from the irritating effects of the feculant discharge. If this is copious, thin and watery, it might be controlled by continuous suction drainage. If the discharge is thick the wound should be dressed almost hourly. The diet should be constipating, unless definite contra-indications are present, and fluids by mouth should be restricted. Fistulæ as low as these in the intestinal tract really threaten the life of the patient by inanition. In this series of 2841 cases it was not the direct cause of a single death. As a matter of fact in some cases, complicated by intestinal obstruction, a fistula is often a life-saving measure by establishing automatically an efficient ileostomy or cæcostomy.

The majority of these fistulæ occur within the first two weeks, from the seventh to the fourteenth day after operation. Fifteen developed in the first week, twelve in the second and three in the third. The fistulæ which made their appearance early took longer to heal than those which developed later, those occurring the first week usually drained for two, while those which discharged the second week invariably closed within a few days.

It is not without interest to note that one-third of these fistulæ developed in the first decade of life, and that sixty per cent. occurred before the age of twenty-one. This in itself means nothing, because after all appendicitis is a disease of the young, but the great natural reparative powers of youth may be one of the important factors causing the spontaneous cure of most uncomplicated fistulæ.

Provided there is no mechanical reason, such as a lip fistula, or obstruction distal to the intestinal opening, the majority of fecal fistulæ of appendiceal origin will heal spontaneously. One fistula which drained for two months closed spontaneously without operative interference. This certainly should convince the skeptical opponents of prolonged conservative treatment. Sixty per cent. of the cases in this series healed with conservative treatment and only twelve per cent. needed operative interference. Ten per cent. either left the hospital against advice or were discharged to continue their treatment in convalescent homes with instructions to return to the hospital at some future date should operative repair be necessary. Twelve per cent. of the patients with fistulæ died of some other more direct cause.

Of the four cases subjected to surgical interference three had been given a fair trial of prolonged conservative treatment. One case, however, was operated upon seven days after the primary appendectomy. This was a patient with a severe peritonitis who was extremely ill, and inasmuch as the fistula presented in the wound an attempt was made to close it by simple suture. The patient died one day after the operation. The other three cases left the hospital well; one was cured by an ileocolostomy with resection of the terminal ileum and ascending colon, the second by resection of the ileum with end-to-end suture anastomosis for ileal fistula, and in the third case the sinus tract was dissected to the cæcum where its base was inverted by purse-string suture.

CONCLUSION AND SUMMARY

1. In a series of 2841 consecutive cases of acute appendicitis 1.1 per cent. developed fecal fistulæ.

2. Fecal fistulæ are most frequently seen in cases of acute gangrenous appendicitis and abscess.

3. Rough surgical manipulation and improper drainage materials contribute to the formation of appendiceal fecal fistulæ.

4. The incidence of appendiceal fecal fistulæ appears less with the "simple drop" method than with the inversion of the appendix stump.

5. When fecal fistulæ are once established drainage tubes should be shortened or removed if feasible, or ones of smaller calibre should be substituted.

6. The great majority of fecal fistulæ of appendiceal origin will heal spontaneously if treated conservatively. In this series only twelve per cent. were subjected to surgical interference.

The author wishes to express his thanks to Dr. Edwin Beer, Dr. A. A. Berg, Dr. Charles Elsberg, Dr. Howard Lilienthal and Dr. A. V. Moschcowitz for permission to review the cases of acute appendicitis occurring on their respective services.

POST-OPERATIVE GAS BACILLUS INFECTION OF THE ABDOMINAL WALL*

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Gas bacillus infection of the abdominal wall is a very rare complication following laparotomies. In spite of abundant literature on the fecal anaërobes and infections caused by them, extensive search has revealed only a few references to this particular condition. Its serious import when it does occur, and the appearance of two cases at the Robert Packer Hospital, within two years, have prompted a study to determine what risk of such infection besets the average patient.

In this discussion gas bacillus infection includes all infections caused by fecal anaërobes, such as Bacillus tetani, B. Welchii, Vibrian septique, B. œdematiens, B. fallox, B. sporogenes, B. histolyticus, B. putrificus, etc. Those mentioned are the most frequently encountered anaërobic bacilli and clinically the most important. Of this group B. Welchii is undoubtedly of prime importance.

The Robert Packer Hospital is situated in an agricultural district. Within a radius of 100 miles there are only thirteen cities of 25,000 or more population. One-half or more of its patients are farmers or are engaged in outdoor rural occupations. The frequency of anaërobes in such an environment should be greater than in the metropolitan districts. This presumption is strengthened by the fact that during the period covered by this report there occurred, in addition to the cases already mentioned, five cases of tetanus and three cases of gas bacillus infection of other parts as follows: knee, arm and leg. However, during the past fifteen years of this hospital's present management, post-operative gas bacillus infection has occurred only twice in approximately 7000 laparotomies.

In view of the known habitat of the fecal anaërobes, a study of the intestinal flora of this particular district was undertaken, even though similar studies had been made by other observers in other districts. A review of the other reports reveals many discrepancies.

Dungeon and Sargent,[1] in a study of the bacteriology on appendices in England in 1905, found no anaërobes. On the other hand, Lanz and Tavel [2] found bacillus œdematis maligni in 49 out of 139 cases of appendicitis. Under bacillus œdematis maligni they included various other anaërobes, including bacillus Welchii. Runeberg,[3] in 1908, found bacillus Welchii once in 14 cases of appendicitis. Hyde and Frederick's Clinic in Marburg,[4] in

* Thesis submitted for M. S. degree to the Post-Graduate School of the University of Pennsylvania.

1911, concluded that anaërobic bacteria were found in 100 out of 102 cases of appendicitis studied. Grigoroff [5] found bacillus Welchii present nine times in 31 cases of appendicitis. Simonds [6] and Jennings [7] had similar results. Welch,[8] Flexner,[9] Wright,[10] Stokes [11] and others were able to isolate bacillus Welchii from 22 per cent. of peritoneal exudates following peritonitis.

Winter,[12] in 1899, was the first to describe emphysema of the abdominal wall after laparotomies, and reported two cases. Madalener [13] reported two more cases, and claimed that the posture with the hips elevated was of predisposing moment in the origin of the emphysema, while Leopold and Brosin [14] had already proved that the condition could arise after operations, regardless of the patient's position. Heil [15] contended that emphysema could only develop after imperfect closure of the incision. He collected 20 cases from the literature.

Russell [16] reported two cases in 1897 from the gynæcological service of Johns Hopkins Hospital, one following suspension of the uterus for retroflexion, the other following a panhysterectomy in which the intestine was inadvertently opened.

Among the cases collected by Doctors Welch and Flexner [17] are several following perforation of the gut, showing that the organisms must exist in the intestine. This is of particular interest when one considers the frequency of intestinal injuries in abdominal operations. None of the above cases were bacteriologically proved.

In very recent literature two cases have been reported of true gas bacillus infection of the abdominal wall. Bier [18] reported a case which developed in forty-eight hours after appendectomy. Under appropriate treatment, instituted early, the patient made a good recovery.

Ochsner and Schmidt [19] reported a case developing after an appendectomy for a perforated appendix associated with abscess formation. Likewise this patient made a good recovery.

An extraordinary case has been reported by Daton [20] of gas bacillus infection involving the neck, supra- and infra-clavicular spaces, following a perforated gastric ulcer. Rapid involvement of the entire body took place within an hour after death. Necropsy revealed the presence of gas bubbles in the stomach wall, suggesting that here was the seat of primary infection, particularly as no gas bubbles were observed in the intestinal mucosa.

One case from the Robert Packer Hospital followed an appendectomy; the other followed a colostomy. The histories are as follows:

Case I.—Mrs. H. H., aged twenty-six, stenographer, admitted to this Clinic, March 2, 1924, complaining of pain and tenderness in the right lower abdomen, associated with nausea, vomiting and slight diarrhœa. Examination revealed intense soreness and rigidity in the right lower abdomen. Vaginal examination showed a small mass in the region of the right tube and ovary. The laboratory findings were: White blood cells, 21,000; polymorphonuclears, 92 per cent.; lymphocytes, 8 per cent. Urine showed a cloud of albumin and many granular casts. Temperature, 99.4; pulse, 100; respiration, 24.

A diagnosis of acute perforated appendicitis was made. Immediate appendectomy was performed through a McBurney muscle-splitting incision. An acutely inflamed gangrenous perforated appendix was found lying behind the cæcum. A small abscess had formed. A right salpingitis known to be of long standing was also found. The abdomen was drained by two rubber drains.

The patient seemed listless after operation, but aside from that, there were no alarming symptoms. The temperature and pulse were as follows: 101 F.—100. Seventy-two hours after operation the skin of the lower right quadrant of the abdomen appeared bronzed and œdematous and was crepitant upon palpation. The pulse rate rose rapidly to 124 per minute. These findings aroused the suspicion of a gas bacillus infection of the abdominal wall; hence immediate multiple incision through the skin and subcutaneous tissues were made and a watery brownish, foul-smelling pus evacuated. There was no evidence that the deeper structures of the abdominal wall were involved by this infection. Anaërobic cultures were positive for bacillus aerogeneous capsulatus. The wounds were dressed every four hours with normal saline solution. One hundred and twenty hours later additional multiple incisions were made because the infection had continued to progress. After that the patient gradually improved and was discharged as cured forty-nine days after the onset of the infection.

Case II.—J. H. F., aged thirty-three, an American, insurance agent, entered this Clinic, June 2, 1925, complaining of severe pain in the right lumbar region and the right lower abdomen. This attack had begun suddenly, one day before admission. The pain had not been referred to any other parts, nor had it been associated with any nausea, vomiting or urinary symptoms. A similar attack, one week previous to admission, had subsided in three days. Attacks of pain in the right side dated back fifteen years. There had been no previous operations. Physical examination was negative except for slight distention, rigidity over the entire right abdomen and very active peristalsis. The admission findings were: Temperature, 99; pulse, 74; respiration, 20. White blood cells, 9800; polymorphonuclears, 81 per cent., small mononuclears, 19 per cent. Urine showed a few pus cells. Röntgenogram of the kidneys and ureters was negative. A provisional diagnosis of acute intestinal obstruction of unknown origin was made.

Immediate laparotomy through a right rectus incision was performed. An acute intestinal obstruction due to volvulus of the cæcum, ascending colon and part of the transverse colon was found. The volvulus was caused by adhesions between the ascending and transverse colon. These adhesions were separated, relieving the obstruction. Over-distention of the large bowel was relieved by a cæcostomy fashioned after a Witzel enterostomy. Sixty-seven hours after operation the patient developed a gas bacillus infection of all the structures of the abdominal wall. The pulse rate at this time was 130 per minute. Immediate multiple incisions were made through the skin, subcutaneous tissues, fascia and underlying muscles. The wounds were dressed by the Carrel-Dakin technic. Patient died ninety-six hours after operation in deep toxæmia.

Note that in the first case the infection was limited to the superficial tissues only, while in the second case all the structures of the abdominal wall were involved.

Prompted by these two cases the following studies of intestinal flora were undertaken: 1. Bacteriological studies of appendices removed at operation. 2. Bacteriological studies of appendiceal abscesses. 3. Bacteriological studies of large gut and ileum. 4. Bacteriological studies of free pus in the peritoneal cavity.

Cultures were taken under aseptic conditions and planted in litmus milk. The resulting cultures were incubated continuously, the reactions being noted at twelve-hour intervals. After seventy-two hours all cultures were examined

microscopically. Cultures showing early stormy fermentation or rapid clotting of the milk, associated with the production of gas, were examined immediately for the presence of bacillus Welchii or other anaërobes. In all sixty-nine cultures were examined at varying periods after original cultures. These were distributed as follows: From appendiceal abscesses, 5. From the lumen of excised appendix, 60. From lumen of large gut, 2. From free pus in peritoneal cavity, 1. From lumen of excised ileum, 1.

Of the five cultures of appendiceal abscesses four showed formation of acid and gas, two within the twelve-hour period, while one culture showed no change whatever. Thirty-seven cultures from excised appendices showed the production of acid and gas associated with clot formation, one within twelve hours of original culture. Seventeen cultures showed only the production of acid, while in six cultures there was no change. There was acid and gas production in all three cultures from the gut. In the culture from pus in the peritoneal cavity, acid, but no gas, was produced. When examined microscopically none of these cultures showed the presence of bacillus Welchii or other anaërobes, nor did any of the patients from whom these cultures were taken develop gas bacillus infection of any part. Nearly all positive cultures showed bacillus coli, diphtheroids or streptococci in varying combinations.

Conclusions.—1. Post-operative gas bacillus infection of the abdominal wall is a very rare complication, but serious when it occurs.

2. There is relatively little risk as gas producing anaërobes were not found in any cultures made.

3. Suspicion of such a complication should be aroused by a sudden increase in pulse rate, with or without a rise in temperature, in a patient who is not doing well after operation.

4. The diagnostic signs are copper colored bronzing of the skin, with œdema, brownish, foul-smelling discharge from the wound, crepitation, and positive bacteriological smears.

5. Treatment should be prompt multiple incisions and free drainage.

6. The prognosis depends upon the extent of the infection.

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POLYCYSTIC KIDNEY *

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Some four or five years ago Barnett was able to collect 251 cases of polycystic kidney reported up to that time and analyzed them comprehensively. Since then over 238 additional cases have been reported with no valuable scientific addition to our knowledge of the disease excepting a more accurate degree of diagnosis. This increase in the number of cases diagnosed before autopsy is without question due to the additional aid of pyelography. While as a means of diagnosis, it is confined to the urologist, still facilities are now universally available for suspected cases. If as a routine measure kidney conditions showing pus in the urine and other features demanding a visualization the upper tract are so examined it is more than probable that the relative incidence of early diagnosis may be increased.

Fig. 1.—Photograph of kidney described in Case I. Note the projecting cysts and the general distended appearance of the kidney resembling a larger ovarian cyst.

It is interesting to note that in the hospitals of Greater New York the total number of cases reported for the last four years, exclusive of 1922, averages less than 8 cases annually. Hence the report of six cases herewith may be considered important.

Cases may be classified in four types. First, those in which the appearance of renal insufficiency appears and the patient quickly succumbs. This

* Read before the Association of Italian Physicians, April 9, 1926.

type illustrates the point that an extraordinarily small amount of kidney tissue is necessary to sustain life. In these cases the development of an additional cyst with corresponding pressure on the remaining kidney tissue is enough to bring on the uræmia. With the almost complete kidney destruction, there is no hope of a response to treatment and death soon occurs. These cases are obviously discovered only at autopsy.

The second group embraces those cases presenting symptoms of chronic

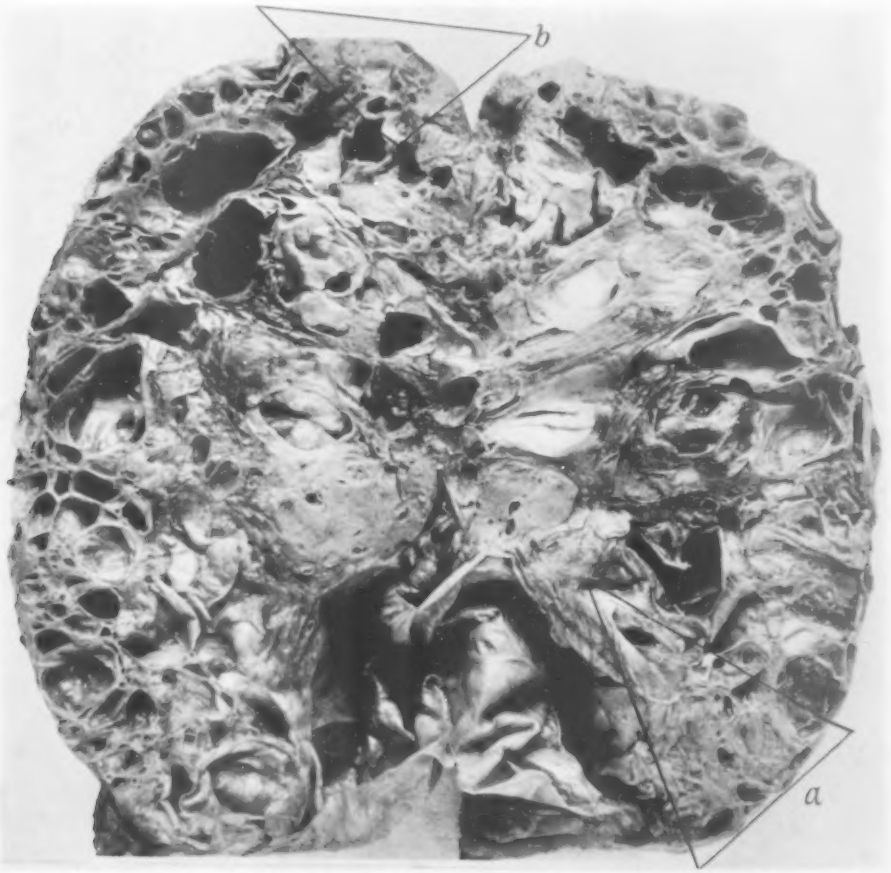

FIG. 2.—Kidney divided. Note areas indicated a and b, as the only remaining portions of normal kidney tissue where the structural arrangement of the kidney tissue continues down to the pelvis.

nephritis. The patient complains of dull back pains, headache and the usual symptoms met with in chronic renal disease. Further examination shows the presence of casts in the urine; visual disturbances may be caused by an albuminuric retinitis; nausea and blood-pressure changes occur. Diagnosis is difficult especially if the cysts remain small. If there is a corresponding inflammatory change in the capsule, the development of the cysts is in a measure limited at least as to size. A thin normal capsule has a tendency to expand. It is in this type of case that symptoms are deferred, until the kidney can be palpated. Compression of the kidney substance between the

firm unyielding capsule and an increasing tension within the cysts give rise to the same situation as in interstitial nephritis with similar symptoms. On the other hand, the capsule may exert a certain influence in keeping kidney tissue in alignment. It seems certain that once when the cysts develop, that a vicious circle is established and the collecting tubule is interfered with by neighboring cysts. In other words, the kidney tissue undergoes an atrophic degeneration as the result of an intracapsular pressure.

FIG. 3.—Pyelogram of left kidney described in Case II. Actual size. Note normal size of ureter and tremendous increase in proportion both as to contents and extent of kidney pelvis.

A third type of cases includes those in which symptoms appear that direct attention to the urinary tract. The development of cysts adjacent to the pelvis may set up a hemorrhage within the pelvis and cause the appearance of bright blood in the urine. The passage of blood clots down the ureter may even induce a so-called clot colic. Cystoscopy and pyelography very quickly determine the nature of the disease; in fact four of the cases presented herewith fall within this third class.

It would not seem that further knowledge as to the pathology will influence the result of treatment. We are dealing with a congenital defect the embryology of which is uncertain. However, lessened kidney function exists and treatment must be directed toward minimizing the strain on these organs. In other words, the treatment problem is the same as in a chronic nephritis.

With reference to pyelography as an aid to diagnosis, its value cannot be overestimated. Its use is to be accompanied with a certain degree of caution. It has been our experience that the physical reaction to pyelography is determined by the amount of pathology within the pelvis. Cases with actual disease—pyonephrosis, tuberculosis, pyelitis, etc.—and particularly those with a marked hydronephrosis, frequently have no reaction whatever. Cases of renal pain due to stone in which the obstruction has existed for a short time, experience great pain from the irritation of the sodium iodide on the mucosa. Insofar as these cases of polycystic kidney have no pelvic involvement, the reaction is liable to be severe. With the possibility of a reflex suppression one must consider carefully before pyelography. In one of our cases death occurred two weeks after pyelography, and this should be charged against the procedure.

If there is a disturbance of the nitrogen equilibrium and the blood chemistry shows a high urea, the examination should be cautious. Immediately afterwards the patient should be put to bed, heat applied to both kidneys, colonic irrigations given and in general an attack of suppression anticipated. This practically eliminates the possibility of untoward results.

Numerous examples of nephrectomy for a kidney tumor, afterward discovered to be polycystic, are on record. In one case a colleague operating for a gastric condition noted an enlarged kidney; twice its normal size, and did a transperitoneal hysterectomy. The mortality in these cases has been so high that the procedure is out of question.

FIG. 4.—Right pyelogram of kidney described under Case III. This diagram drawn to scale from pyelogram.

In 22 cases of nephrotomy or nephrostomy the mortality has been 31.8 per cent. Only two patients are reported still alive after two years. Nephropexy and decapsulation have been done a few times. The most efficient

procedure has been puncture or incision of the cysts. The method of puncture has been championed by Rovsing, who advises that the kidney be exposed and multiple punctures of the superficial and deep cysts carried out. In two cases Rovsing reported that remarkable amelioration has occurred, that the renal function was considerably improved, and that pain, which had been present, had disappeared. Other surgeons have confirmed these results, while some have reported failures. Kuster recommends that the superficial cysts be excised as completely as possible. The incision may be done with or without cauterization. Brin collected 16 cases, treated thus, with 4 deaths (25 per cent. mortality). The duration of the results in those who lived cannot be given. When the case is complicated with unilateral infection and suppuration, a calculus with hydronephrosis, or tuberculosis, operation may be indicated and perhaps safely carried out on the affected side, but the fact that the other kidney is practically always polycystic makes any extensive operation hazardous. When fever, associated with anuria or uræmia, occurs, one may consider operating upon a badly infected side, but, as a rule, such operations are dangerous.

FIG. 5.—Copy of pyelogram of Case IV, drawn to scale. Note dimensions of pelvis reaching to the eleventh rib above and to the brim of the pelvis below. The kidney itself obviously extended much further than this. Note normal size of ureter.

One may, therefore, sum up the situation in advising that medical treatment, as a rule, is the method of choice. In some instances surgical evacuation of the cysts may be justifiable.

ILLUSTRATING TYPE I

CASE I.—M. S., Italian, fifty-two years of age, married, eleven children. Backache for six months with nausea, vertigo, dyspnœa. Worked daily. Three weeks before—taken acutely ill; sent to the hospital. Swelling of both legs and ankles. Cardiac irregularities; shallow respiration; considerable drowsiness. On examination, two large masses could be made out in the abdomen, apparently kidneys.

Patient excreted about 2000 c.c. urine daily; specific gravity 1.110 with traces of albumin. There was no marked increase in the blood nitrogen and renal functional tests showed a return of 10 per cent. of phenolsulphonephthalein the first hour and 10 per cent. the second hour.

Diagnosis of bilateral polycystic kidney was made. Under a strict nephritic régimé, moderate improvement was made and the patient left the hospital to spend a few days at home over Easter. Suddenly the patient developed acute symptoms of vertigo, dyspnœa, and died at home.

Autopsy showed well developed polycystic kidney.

Case II.—E. P., forty-seven years old treated for several years for chronic nephritis, renal insufficiency, etc. Finally definite tumor mass made out in abdomen and identified as kidney. Operation considered but general condition of patient was so poor that any procedure was inadvisable. Slight improvement noted following strict nephritic treatment. Daily output of urine 1200 to 1500 c.c.; blood nitrogen 37.6 mgs. of urea; nitrogen per 100 c.c., creatine 3 mgs. per 100 c.c. The laboratory findings showed a tendency to improve but apparently more cysts developed; the patient became uremic and died.

Autopsy showed tremendous sized kidneys, each the size of a small watermellon. A pyelogram of the two kidneys is shown below. This was made after the organs had been removed from the body. It is interesting to note that in this case the patient had a perfectly normal ureter and the uterus was infantile in type. This brings out the point that has been previously stressed, namely that in all cases of renal anomalies, there are usually associated stigmata of development elsewhere in the body. This is true in many other genito-urinary conditions. For example epispadias and hypospadias are frequently found in conjunction with the duplication of the ureter, bifid kidney pelvis, etc., and in the presence of easily recognized external difficulties should make one suspicious of abnormalities elsewhere in the tract.

Fig. 6.—Pyelogram of case described as Case V. Pelvis not greatly enlarged, although it extends from twelfth rib to brim of the pelvis. Note displacement of ureter inward and the manner in which it apparently rides over tumor formation and the lower pole to the kidney. The cystic change had apparently been limited to this portion of the kidney at the time of the examination.

ILLUSTRATIVE OF THE SECOND TYPE OF CASE ARE THE FOLLOWING TWO CASES

CASE III.—Male, fifty years old, married, no children, mother died of kidney disease. Perinephritic abscess on left side while living in Los Angeles in 1915. It was opened and drained and examination revealed a polycystic kidney. Some sixty cysts were punctured and drained. Two years later a floating or ptosed kidney was found on the opposite side. The chief subjective symptom was backache and pain in the lower quadrant on the right side. The operation had apparently relieved the discomfort on the left side. The urine showed evidence of chronic interstitial nephritis. Both kidneys were palpably enlarged. As a history of polycystic kidney on the left side was obtained, a pyelogram of the right side only was made. The separated urine specimens were obtained and found to be about equal in quantity and contents and comparable to the specimen from the bladder. The phthalein output was four per cent. on the right and five per cent. on the left side in twenty minutes. Forty c.c. of twenty per cent. sodium iodide solution was injected into the right pelvis without the least discomfort. This was drained off afterward with apparently little reaction.

FIG. 7.—Pyelogram of a polycystic kidney. Note dimensions of pelvis which extends above the tenth rib.

CASE IV.—Male, forty-three years old, married, no children, no hereditary history relevant to his condition. Intermittent hæmaturia for varying periods and at varying intervals for twelve years. During this time three examinations by the Life Extension Institute and two by urologists of prominence were all negative. Present hæmaturia began seven days before examination with frequency and urgency day and night. Residual urine fifty c.c. Cystoscopy revealed moderate lateral prostatic intrusion and slight trabeculation. The orifices appeared normal and from the left blood was ejected. Catheters were passed easily to the kidney pelves and the urine collected for ten minutes. The specimen from the left side was mostly blood and from the right, urine of low gravity and urea content with a trace of albumin, and no casts or blood. The phthalein appearance time was twenty-five minutes on the left and twenty-six minutes on the right side. Plates and smears were negative for bacteria. The left kidney pelvis was injected with thirty-six c.c. of twenty per cent. sodium iodide solution without discomfort, and pyelograms were made. The opaque medium was drained off and as the patient has no reaction a similar procedure was carried out on the other side one week later.

The third group of cases present more objective symptoms and the appearance of blood in the urine, together with other associated urinary symptoms makes diagnosis possible at an early stage. In this respect it resembles symptomatology of many other conditions. For example: In carcinoma of the prostate, hæmaturia is distinctly absent and the patient goes on with pain in the back, shooting pains in the leg and general meles without a rectal examination being done until the tumor has reached such a size that complete retention occurs in adenoma of the prostate. The early attacks of congestion and the pressure of adenoma against the prostatic mucosa cause a hæmaturia which draws attention to the bladder neck immediately. So, too, with malignancies of pelvis of the kidney and ureter and hypernephromata which are in relation to the pelvis. In these conditions the relative percentage of complete recovery is much greater in the presence of early bleeding and accurate diagnosis than in tumors of either pole of the kidney which grow to a large size and metastasize freely before causing local symptoms.

Case V.—Male forty-two years of age. Occasional pain in back and one time had pneumonia which lasted for three days. Some doubt as to diagnosis. Six months ago attack of pain in right side which he describes as similar to that experienced during pneumonia. Pain relieved by morphine. Later passed a large worm-like clot of blood in urine and pain relieved. Came for examination two weeks later and cystoscopy done. Differential functional tests showed a delayed appearance time phenolsulphonephthalein on right side six minutes against three on the left side. Urea slightly decreased. Pyelogram showed a moderately enlarged kidney pelvis with the typical distortion of polycystic disease. Pyelogram done on the opposite side one week later and no abnormalities noted. No symptoms now in three years. It is supposed that the cyst formation on the left side had not receded at any great rate at least not sufficient to cause pelvic distortion.

Case VI.—Male, age fifty-one. Pain in back, occasional slight hæmaturia. Red blood cells constantly present in urine. On examination both kidneys can be felt; are slightly enlarged. Patient presents general appearance of mild nephritis. Put on heavy water intake and cystoscopy done. Lessened function noted in both kidneys and pyelography performed. Beginning characteristic pelvic distortion made out more marked on right side.

With reference to hæmaturia as the symptom, it occurred in one-half of the cases quoted by one investigator who recorded 244 from the literature. Hæmaturia was of an intermittent character associated with pain, lasting for several days or weeks and followed by complete remission.

In the recognition of the pyelogram it may be noted that the pelvis is stretched out to four and five times its normal length with the separation of the calyces at each pole where they are in turn stretched farther apart. The general tendency is towards a longitudinal enlargement while the depth of the pelvis is sacrificed but slightly. The pyelographic shadow does not show quite the same lack of tone as that which can be made out in hydronephrosis and inflammatory dilatation of the mucosa. This apparent presence of elastic mucosa may be accounted for by the presence of distended cysts just beneath the pelvis. The stretching out of the calyces over these cysts probably accounts for their increased depth.

This remains largely a medical problem and the principles guiding the treatment of chronic nephritis should be closely adhered to.

Conclusion.—1. In the diagnosis and treatment of kidney conditions, both medical and surgical, the rôle played by anomalies is very great. These anomalies are always associated with pathology.

2. Polycystic kidney occurs in a reasonable percentage of these cases and should be borne in mind for diagnosis.

3. Pyelograph is of unquestionable aid in securing certainty of diagnosis.

4. The treatment is entirely medical.

URETERAL CALCULI*

BASED ON ONE HUNDRED CONSECUTIVE CASES

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INTRODUCTION

In the whole realm of surgical procedure there is to-day no type of problem which calls for such a nicety of judgment in its handling as that of ureteral calculus. The history of ureteral calculus, according to Desnos,[1] dates far back into ancient history. He records the examination of 9000 Egyptian mummies, many of whom showed calculus disease of the urinary tract, but nothing to suggest surgical procedure having taken place. Their real recognition clinically, however, did not take place according to Olympius,[2] of Athens, until the eighth century. Ultzman [3] states that about this time stone cutting had evidently taken place, although the first real operation for any urinary calculi is accredited to Pierre Franco [4] in about 1560.

The surgical treatment of ureteral stone is a relatively modern procedure. Bardenhauer [5] of Vienna is said to have performed the first uretero-lithotomy in 1882. It remained for Tuffier [6] of Paris to really develop the technic in 1888. The method practiced was that of a single incision in the longitudinal axis of the ureter, removing the stone, and suturing the incision in the tube. That this procedure was not extensively practiced is evident by researches of Jeanbrau,[7] who, in 1909, found only 172 recorded cases of ureterotomy. In 1912, Israel [8] of Berlin presented a report of sixty-one operated cases. Following Israel's publication the development of ureteral surgery, particularly that for stone, was very rapid and soon became a definite part of our surgical technic.

The development of the cystoscope devised by Nitze in 1880, the introduction of the ureteral catheter by Albarran, and the establishment of urographic technic by Volkser and Lichtenberg, are, however, the basis of the modern treatment of ureteral stone. They have reduced greatly the surgical procedures on the ureter and economic advantage of this can scarcely be overestimated.

In 1908, Kapsammer, of Vienna, remarked to his class that it was only a question of time when someone would devise a ureteral cannula or catheter that would cast into oblivion most of the surgery of the ureter. This has come to pass in no small way as seen in the results achieved by Crowell [9] and Bugbee [10] with woven catheters, and Buerger [11] with metallic dilators. It would also seem to the author that the greatest present-day achievement is that of Dourmashkin [12] with metallic dilators and rubber bags.

Etiology.—The cause of ureteral stone also presents an interesting chapter, and its evolution cannot be overlooked, both from an historic and scien-

* Read before the Interborough Clinical Society of New York, May 28, 1926.

tific standpoint. The development of the various views regarding the etiology may be divided into three periods. The first we shall call the chemical epoch; this dates from the dawn of history to the early part of the nineteenth century. This is the era in which writers sought to explain the origin of stone in some obscure change of urinary composition.

The second stage may well be called the bacteriologic epoch, in which writers emphasized the influence played by bacteria. This, according to Hunner,[14] includes the last two decades of the last century, and the first years of the present.

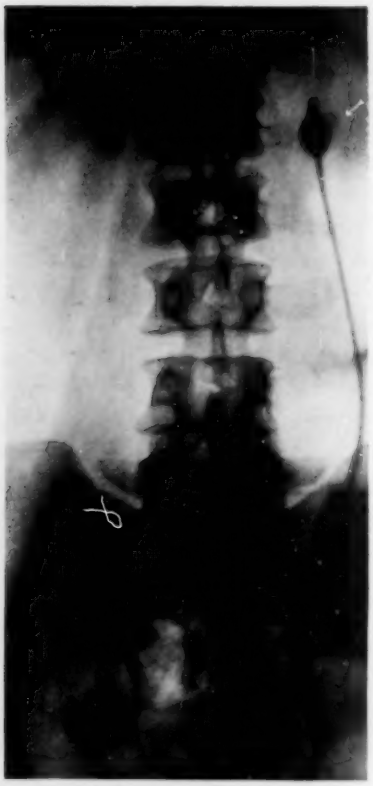

FIG. 1.—Dilatation of ureter in upper third with Dourmashkin bag for stone.

The third period extends also a little way back into the second, overlaps it, as it were. It is the period following the introduction of the ureteral catheter by Albarran and the introduction of ureteral dilatation by Stoeckel, Caspar, Zuckerkandl and others. This period may well be designated as the mechanical era. In it also we have the introduction of extra-ureteral substances as a cause of stone.

The discussion of the chemical theories has extended itself to include those dealing with climate, diet, drink and food. The use of alcohol, which, as we are told is responsible for everything under the sun, must of course bear its share in the disease. Galen regarded high living, gout, rheumatism, etc., as important factors in calculus disease. Sydenham in his works speaks of a calculus diathesis and its relation to rheumatism.

Paracelsus mentions an animal cementing substance. Neubauer and Pagel's[15] story of medicine holds that there is a definite relationship between calculus and gout. Following the very early writers above noted, there is a long gap in the literature and it is not until about 1776 when we come upon Scheele, investigating the solid elements concerned in stone formation. This author speaks of stone acid, phosphorus, oxalic acid, ammonia, and the alkali earths.

In 1776, Fourcroy and Vauquelin speak of a salt-binding substance, which they believe to be an albumin and gelatin. This must be remembered when we come to consider the recently evolved theories of stone formation. Wilson, in 1795, raises up the cudgel against the use of acid food and drinks, drawing attention to the drinking of wine rich in lime. Sedentary habits are also considered as a factor.

In 1800, Sommerman reports his belief in a mucilaginous conglomerating substance occurring in the renal pelvis as a producer of lithiasis.

In 1852, Von Walther noted that there was a great difference between calculi produced without the body (laboratory experiments) and those within the organs. He

produced stones in his laboratory, but found that they were mostly sediment without definite formation.

In 1856, Meckel Von Hemsback mentions the appearance of an inflammatory condition as an adjunct to the cementing material noted by other observers. He attempts to demonstrate that the so-called binding substance will only form in the presence of inflammatory action.

There is again a blank space in the etiological history until 1884. At this time Ebstein in an analysis of a large number of stones noted that they contained a framework of albuminous material. He also felt that this coagulating substance, as he called it, was the result of a local epithelial degeneration. The latter, it was thought, was due to the presence of a local inflammatory action. At this point Posner appears on the scene with a series of studies which would suggest that in addition to the inflammatory action above noted, there is some interference with the urinary flow.

FIG. 2.—The use of the filiform tip bag, in a case of ureteral calculus at its pelvic brim.

In 1900, Harris [16] stated that in his opinion all urinary calculi are of bacterial origin. Harris supports this view by a series of experiments, and reviews many cases in the literature.

Albarran also approved of the bacteriological formation of stone, but believed that there were two types, those of non-bacterial origin, which he calls primary stones. These primary stones he believed formed in the tubules and calyces without definite pathologic change in the kidney substance. In cases where the kidney is the seat of active pathologic process, he believes there is an additional bacterial invasion.

Küster,[17] in 1902, rules out the part played by drinking water, climate, and racial tendency. He attempts to prove that there is a distinct hereditary tendency, and that a uric acid and rheumatic diathesis plays a part. Küster claims that these cases, even in the third and fourth decades, may be traced to a urinary infarct in the young.

Moritz and Mendelsohn believed that each stone has a distinctly albuminous centre, and that calculi are on the borderline between a physiological and a pathological process.

Roberts [18] in his Indian Army service operated upon 3401 of these cases. The patients were natives of the Punjab, a section of the country where the people subsist largely on cereals and leguminous foods. Roberts found this diet to be rich in albumin, phosphates, and in calculus. He also believed the low salt diet is partly responsible for the prolific calculus formation.

Israel [19] in 1912 called attention to the fact that while the etiology of calculus may be in doubt, it is certain that heredity plays a part. He attempts to show that there are many families in which gout, rheumatism, diabetes mellitus, and bladder stone alternate. He also believes that trauma may play a part. Injury to the kidney may cause bleeding, the clot acting as a nucleus on which stone may form.

Bryan [20] speaks of infection following an irritated base; with a superimposed transmural bacillary infection.

In 1914, Fowler [21] brings up once more the theory of urinary stasis, which is undoubtedly a factor of very great import. He states that the stasis may be due to kinks,

prolapsed kidneys, and possibly stricture of the ureter. In connection with this work, we are greatly indebted to Fowler for the introduction of the semi-erect posture in the taking of ureterograms.

In 1916, Hunner [22] began the publication of his interesting work on ureteral stricture. Hunner believes that most stones are the result of a ureteral stricture. Others feel that the stone may produce the stricture. This well known student also quotes Rovsing as believing in the possibility of stone as the result of stricture in the ureter.

Rosenow and Meissner [23] claim to have produced calculi in animals by the injection of a specific organism into the blood stream.

Keyser [24] believes that calculi are caused by chemical precipitation and that geographic distribution, race, heredity, age, diet, and trauma, have little to do with stone formation. Keyser has caused the formation of stone in the urinary tract of animals by producing secretion of urinary crystalloids.

C. H. Mayo [25] considers the hypothesis of infection as the only tenable theory. He has considered the subject of infection and stagnation. Mayo emphasizes the fact that the kidney is an organ of filtration and is constantly eliminating bacteria from the circulation. He believes that two types of bacteria are necessary, one to produce the hæmatogenous infection, the second coming only from a local focus. Bacteria of the stone forming type must come in contact at the time, when the mucoid exudate is present as a result of the primary infection. This is not unlike the theory elaborated earlier by Albarran.

Bumpus and Meisser [26] injected a green producing streptococcus from the teeth, tonsils and blood of pyelonephritic patients in 81 rabbits, producing kidney lesions in 63.

Spitzer and Hilkowitz [27] believe the evidence of stasis and infection is strong. They also add that physiological chemistry, particularly as relates to the colloids, furnishes valuable hypotheses in explanation of stone formation. This is one of the most valuable papers written on this interesting subject, and will be well worth careful reading.

Hager [28] in his recent studies of incrustation cystitis and pyelitis, regards the B. Salmonella and B. proteus as important factors in stone formation.

Lau [29] notes that B. coli, B. pyocyaneus, or B. proteus were present in all cases.

In our own observation of one hundred cases of renal and ureteral calculus, one fact has impressed us strongly. That is that there is an infection plus an interference with the urinary flow easily demonstrated in practically every case. Not only do urinary calculi cause obstruction, but they are quite definitely the products of an obstructive uropathy.

Pathology.—Having as we believe quite clearly demonstrated that stone represented infection plus obstruction, it is evident that inflammatory action must be present. There is therefore a chronic pyelo-ureteritis or cysto-pyelo-ureteritis which begins in the pelvis of the kidney and often ends well within the urinary bladder. This represents the changes in the mucosa and submucosa, and is present in varying degrees in practically every case. We have previously called attention to the anatomy and physiology of the ureter and its importance in obstructive lesions. On examining the ureter we note that it is composed of three coats, an external fibrous, a middle muscular layer, and an internal layer or mucosa. The outer investment is rather loose and becomes a little denser as it nears the bladder. The muscular portion is made up of an external and internal longitudinal layer and a middle more or less circular fibre.

The mucosa is lined with epithelial cells of a columnar type, about four

cells deep. This brief review of the histology will aid us in appreciating the pathology in lesions of varying duration.

In a case of stone which has but recently appeared in the ureter, the involvement of the mucosa is all that is noted. When there are one or more stones present over a period of time, there is a gradual accumulation of a round-cell infiltrate into all the layers of the ureter. A condition is superimposed that we may well designate as a chronic interstitial ureteritis. This is not always limited to the immediate area of the stone, but at times extends a considerable distance beyond it.

FIG. 3.—Two stones near ureteral orifice, after three dilatations with elastic bag.

This condition should be remembered, although it is not mentioned in any of the works on this subject. The infiltration is often very dense and gives one a very erroneous conception of the size of the stone. We have recently seen one case in which on X-ray examination it appeared as if there was a mass of stone about one inch long. At operation the stone was found to be very small, but the ureter heavily infiltrated around it. It is rare that the loose external coat becomes involved, except in those where the stone becomes lodged in a pouch. In these cases there is often pus in the sac, and condensation of the surrounding tissues with the formation of adhesions. In addition to the frequency, it must be evident that as the result of an obstruction of stone, there is a further deposit of salts around the area, and at times an infiltration with lime salts. Dilatation of the ureter above the stone seldom occurs to a marked extent, except in the cases of complete obstruction. This is incident to the fact that the vast majority of stones which lodge in the ureter quickly become grooved, so that a small amount of urine is always passing. This groove is easily demonstrable. The ureter below the stone is sometimes quite œdematous, and this is particularly marked in stones near the ureteral orifice. This is so striking that œdema of this tube as it enters the bladder should call up the thought of stone in the ureter. The gross renal pathology and its association with ureter stone is beyond the scope of this sketch.

Symptomatology.—A review of the literature would rather lead one to suspect that there were certain absolutely diagnostic features of ureteral calculus. Nausea, vomiting, hæmaturia and pain are the chief symptoms. Associated with this are of course frequency and urgency. Any one of

these symptoms may occur in almost any renal or ureteral, in fact, any genito-urinary affection. We are told that the pain usually begins as a sense of uneasiness, followed by a dull ache of increasing intensity. This characteristic pain, so-called, is of very great violence; the patient doubles up into a knot and goes through all sorts of acrobatics in an attempt to relieve it. Kilbane, on investigating a number of women who had borne children, stated that the pain with stone is worse. We can testify from several personal attacks that there was little doubt as to its violence. However, this is by no means always the case. In many we have found a persistent dull ache over a portion of the kidney or ureter. The location of this pain is, however, no index as to the location of the stone. These attacks of stone pain may occur often, or may be a very long distance apart, at times the periods are even a year or more distant. Pain we believe is due to obstruction of the ureter and distention of the renal pelvis. It is very much like that produced when the pressure system of pelvic distention is used in pyelography.

FIG. 4.—Dilatation of ureter in lower third for calculus. Rubber bag dilator in use.

Hæmaturia is practically always present and varies from microscopic bleeding to a very pronounced bloody urine. The appearance of blood visible to the naked eye as a whole only occurs at irregular intervals, and is at times pronounced during an attack of colic.

Gastro-intestinal symptoms, such as nausea and vomiting, only occur in an acute attack.

Urgency and frequency are at times complained of, but are by no means constant. At other times there is an inability to empty the bladder, which at times extends to an incontinence of retention. A febrile movement and a leucocytosis are usually present to a more or less extent. This is particularly true of the latter, which will at times range from 20,000 to 30,000. The cases with a high leucocyte count require very careful thought as they are the ones most liable to require operative interference.

Pus in the urine is another symptom which is constant, but may occur in any other urinary lesion. The remark made by a prominent urologist that a few pus cells in the urine indicates a pyelitis we believe is fraught with great danger. Those of us who have examined thousands of men know how this lesion persists after any old urethritis of gonococcus origin.

The point we are endeavoring to drive home at this time is that any case

presenting a symptom group, with pain, hæmaturia, urgency, frequency, etc., or in fact, any or all of these signs or symptoms, calls for a complete urological examination. With such a picture we can only do justice to a patient with cysto-urethroscopy, ureteral catheterization, renal function tests, and pyelography.

Age.—Stones may occur at almost any age. Bugbee and Wollstein [30] found them in thirteen children, twelve of whom were under eleven months, and one in a child of eleven days. Thomas and Tanner [31] reported 203 cases of renal and ureteral calculus in children up to fifteen years, the average age being 7.8 years. In 112 the stones were discovered by the X-ray. In our group the youngest case was five years. This child also showed stones in the kidney and bladder. The following table shows the age incidence in our series:

Age	Cases	Age	Cases
5	1	48	7
19	3	51	13
28	8	54	4
31	15	57	2
32	9	60	3
35	11	63	4
36	18	68	1
39	10	72	1
			100

Sex.—In regard to the sex, our list shows about three women to every man. This would be the logical expectation, in view of the renal infections plus obstructions which occur in the urinary tract of women. This applies particularly to those who have borne children.

Location.—A composite of the large American clinics on ureteral stones shows that about 76 per cent. were found in the lower third of the ureter. The teaching that stones were liable to locate at the natural constrictions of the ureter is now known to be incorrect. They may locate anywhere. By location, we should state that we mean impaction. The lower third of the ureter is quite well protected by constricting muscle, which accounts for the frequent location of stone. This includes the portion which is in the wall of the bladder, the intravesicular section. It has frequently been demonstrated that stones drop readily from the renal pelvis into the more constricted lower third of the ureter. However, at times even very small stones become impacted in the upper ureter. Multiple impacted stones are not common, as in records of 500 cases we saw notes of two or more in 21 cases.

Diagnosis.—In a recent paper the assertion has been made that the difficult cases to recognize were those in which we do not find a typical history. Human beings in various parts of the world respond differently to the presence of disease. We may even go a step further, and say that every person is a law to himself. With this preface, we must explain that in our experience with one hundred consecutive cases, the atypical type was distinctly more frequent. About 80 per cent. of ureteral stones will show clearly on

a plain X-ray film, but it is often impossible to tell definitely if they are in the ureter. The taking of a röntgenogram with an X-ray catheter in the ureter is helpful, but not entirely conclusive. How, then, may we make a definite diagnosis? Bransford Lewis,[32] in 1922, showed that a picture first taken with a soft catheter and later with his ureteral dilator in place, the shadow would follow the dilator, provided the calculus was in the ureter. In 1918, Mr. Ball,[33] of the Presbyterian Hospital, Chicago, suggested the double exposure method. It has been extensively employed by Kretcher and by the author in ureteral stone. In case of a possible ureteral stone, the X-ray catheter is passed in the usual way. The Coolidge tube is then centred, and a picture taken in the usual way. The tube is then moved about two inches off centre or inclined slightly and a second exposure made. When the stone is in the ureter, it follows the ureteral shadow, or in other words, appears in the same relation in both exposures.

FIG. 5.—Illustrating the renal and ureteral pathology, following a calculus obstruction in the lower ureter.

The extent to which ureteral stone is mistaken for appendicitis is by no means a great credit to surgeons. Scars over the appendix in these cases are very common. Not long ago we heard a prominent surgeon remark that about 15 per cent. of stone cases had their appendices removed when appearing on his service. One of the reasons for this diagnostic error is probably the frequency with which calculi become impacted close to the bifurcation of the iliac vessels, and in the vicinity of McBurney's point. The differential diagnosis in this case should not present much difficulty. A complete urological examination will definitely decide the point. We must not leave this particular section without reminding you that an acute appendix and ureteral stones are at times coexistent. A very important chapter in the diagnosis of ureteral stone (particularly in the lower portion) was added by the introduction of vaginal palpation by A. M. Judd.[34] We have been enabled to verify Judd's statements by palpating the stone in the lower ureter in five cases by the vaginal route.

Treatment.—What technic shall we employ in the management of ureteral calculi? The answer to this can seldom be given without a thorough understanding of the factors underlying each case. The methods of treatment may be divided into manipulative and operative.

Thomas[36] of Minneapolis has formulated the indications for operative procedure as follows:

1. When a ureteral stone is large, that is, usually more than 2 cm., and when it does not progress through the ureter.
2. When the kidney is being distended.
3. When reflex anuria occurs.
4. When other diseases contraindicate long attacks of pain.
5. When the patient cannot withstand, without severe reaction, the cystoscopic examination.

This we believe is a very sound basis for considering operative approach and one which we have followed with a great amount of satisfaction. When our examination shows us that our patient cannot be grouped in the classification just noted, what shall we do? What methods of treatment are at our disposal?

Bransford Lewis, in 1904, demonstrated that the simple passage of a ureteral catheter will sometimes dislodge the stone. Braash and Moore believe that it is the change of its axis which allows the stone to descend. Crowell and others believe that the injection of lubricants through the catheter is at times of value. We share the opinion of Andre that it is the passage of the catheter that does the trick.

Beer has demonstrated the great value of the indwelling catheter and reports about 60 per cent. of successful cases.

Peacock reports 50 per cent., Crowell 65 per cent., Dourmashkin 70 per cent., Walther 88.9 per cent., and Ballenger and Elder[26] about 90 per cent. of stones removed by catheter and bougie manipulation.

In a series of 23 cases of ureteral stone reported before the New York Academy of Medicine, we reported 22 removed by treatment with Dourmashkin dilators. Following the experimental work of Illievitz[27] on dogs, Dourmashkin dilated the ureter of human beings to 50 Charrière with rubber bags.

FIG. 6.—Illustrating the use of the double exposure technic. The stone shadow remains in contact with the catheter in both pictures. Calculus is therefore in the ureter.

Undoubtedly dilatation is the *sine qua non* in the treatment of ureteral calculus. If the stone does not respond to simple catheterization and the use of indwelling catheters, progressive dilatation must be employed. Beginning with the largest size bougie possible, the ureter should be dilated up to a number twelve at weekly intervals. Following this the bulb dilators should be passed up to the stone, the ureter dilating below it. When the ureter has been dilated to 8 or 10 C., the dilating bags of Dourmashkin may be employed to great advantage. Following a wide dilatation with this instrument, the stone will often quickly appear at the ureteral orifice, on withdrawing the catheter.

We are certain that the causes of failure in ureteral dilatation lie in the

fact that they were not carried high enough. The ureter is much less sensitive than supposed, and can readily be carried to at least a number 20 Charrière bulb. The Dourmashkin bulb being elastic, it can be carried much higher without any danger.

How long shall we continue dilatation? There is no definite time limit, although in some of the European clinics they limit it to six months. The real answer, however, is until you get results. What are the effects of long-continued dilatation on the ureter? Dourmashkin tells us that in over 150 cases he has seen no ill effects. In one hundred cases, we have noted no disturbance of the parts.

In the manipulation of stones in the lower ureter, it will be noted that at times they are quite mobile. With this group of cases, the expulsion of the stone can be greatly facilitated in women by stripping the ureter through the vagina as recommended by A. M. Judd. Walther has stated that the same procedure is applicable in the male, by utilizing rectal palpation of the ureters. We have not been able to apply the latter method successfully.

The following table shows our results in one hundred consecutive cases:

Location of stone	Passed without instrumentation	Operative removal	Discontinued treatment	Remaining	Total
Upper third of ureter	19	2	1		22
Middle third of ureter	31	1			32
Lower third of ureter	42		2	2	46
					100

In the treatment of ureteral stones, as with everything else in the world, one should not allow himself to become hide-bound by any one set of rules. If he cannot succeed with dilatations, ureterotomy is the only recourse. In handling this type of case, the surgeon must also be on his guard constantly for signs of suppression of urine or an acute pyelitis. This may at once change the whole aspect of the case and demand immediate ureterotomy. Close observations of the urine and an eye on the blood chemistry for increasing nitrogen retention are of the utmost import.

SUMMARY

1. Ureteral calculi are the result of obstruction plus infection.

2. The Bacillus Proteus is one of the most important factors in stone production.

3. Many ureteral calculi pass through the ureter without recourse to any treatment, but many become impacted in the ureter.

4. The most frequent point of impaction is in the lower third of the ureter.

5. A calculus once impacted may shut off the flow of urine, but does not

necessarily do so on account of the presence of a drainage groove in the stone.

6. Calculus seems to be a disease of middle life.

7. Our statistics show a predominance in women.

8. Hæmaturia and pyuria are present in almost all cases.

9. In about 95 per cent. of cases the calculi are solitary.

10. Ureteral dilatation should always be tried, in those in which a marked pyelonephritis is not present, or other contra-indications do not exist.

11. Dilatation of the ureter has been found successful in from 60 to 90 per cent. of the cases.

12. Dilatation failing, extraperitoneal ureterolithotomy is the operation of choice.

NOTE: The plates representing the use of the bag dilator are from the service of Dr. R. L. Dourmashkin, who has kindly permitted their use.

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ABNORMAL DESCENT OF THE TESTICLE*

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Malposition of the testicle may consist of an abnormal descent or an ectopia. In the former the testicle may be arrested in its normal descent either within the abdomen, in the canal, at the external ring or the upper part of the scrotum. An ectopic testicle may lie in the upper part of the thigh, on the aponeurosis of the external oblique between the external ring and the anterior superior spine, at the root of the penis or in the perineum.

Descent of the Testis.—The development of the sexual glands, in both sexes, is attended with conspicuous migration from their original position on either side of the upper two lumbar vertebræ, opposite the lower pole of the kidney. In the case of the testis, this migration is so extensive that by birth the organ usually has passed through the abdominal wall and entered the scrotum, having completed its so-called descent.

Certain peritoneal folds (mesenteries) and fibro-muscular bands (ligaments) merit brief description, since they are more or less concerned in the migration of the sexual glands. The Wolffian body is enclosed and attached to the posterior body-wall by a fold (mesonephridium), of which the upper elongated end is continued to the diaphragm (plica phrenico-mesonephrica). The early sexual gland is also provided with a mesentery (mesorchium or mesovarium), that above and below is continuous with folds that pass from the upper and lower poles of the gland to the mesentery of the mesonephros. Within the inferior plica, of the two much the better marked, lies a fibro-muscular strand (the ligament of the testis or ovary), that below is attached at first to both the Wolffian and Mullerian ducts. Later, owing to the atrophy of the one or the other of these ducts, according to sex, the ligament of the testis remains connected with the Wolffian duct and the ligament of the ovary with the Mullerian duct.

A second band of muscular tissue appears within the lower part of the inguino-mesonephric fold, and has its upper attachment also to the Wolffian and Mullerian ducts at a point about where they receive the insertion of the ligament of the testis or ovary. The lower end of the band blends with the subperitoneal tissue of the anterior abdominal wall in the vicinity of the future abdominal ring. This band, the genito-inguinal ligament, corresponds with the gubernaculum testis in the male and with the round ligament of the uterus in the female. In the former it is not directly attached to the testis, but only through its ligament, the point of attachment later corresponding to the origin of the vas deferens from the epididymis.

* Read before the New York Surgical Society, November 10, 1926.

The testicle begins its descent during the second fœtal month, coincidently with commencing atrophy of the Wolffian body, and, under the influence and guidance of the genito-inguinal ligament, by the end of the third month reaches the anterior abdominal wall in the vicinity of the later internal abdominal ring. This position is retained until the close of the sixth month, when it enters upon its final descent. Meanwhile, the musculo-fascial layers of the abdominal wall undergo evagination, resulting in the production of a shallow pouch, the inguinal bursa, into which a sac of peritoneum, the processus vaginalis, extends, together with the closely associated genito-inguinal ligament. The inguinal bursa, in turn, sinks into the shallow scrotal pouch that has independently developed as an integumentary fold. The wall of the bursa contains the constituents that later differentiate into the coverings proper of the spermatic cord and testicle—the intercolumnar, cremasteric, and infundibuliform fasciæ. Its muscular fibres, prolonged from the internal oblique and the transversalis layer correspond with the cremaster, and surround the genito-inguinal ligament.

Owing to the thickening of the lower end of the latter, a slight elevation appears on the floor of the bursa, which thus seemingly becomes pushed up toward the testis to form the rudiment of what in some animals becomes a well-marked projection, the conus ingualis, but in man always remains insignificant. In consequence of these changes, during the fourth month the testis is displaced upward and its descent temporarily interrupted.

About the beginning of the seventh month, the final descent of the testicle is inaugurated with deepening of the bursa and downward extension of the peritoneal pouch accompanied by the now thickened and shortened genito-inguinal ligament. Although shortening of the latter, together with the pull exerted by the cremasteric fibres, plays an active rôle in drawing the testicle through the abdominal wall and into the scrotum, these factors are undoubtedly supplemented by forces resulting from the growth and expansion of the pelvis and inguinal regions.

The processus vaginalis reaches the bottom of the scrotal sac in advance of the testicle, which, drawn from its mesentery (mesorchium), descends outside and behind the peritoneal pouch that later constitutes its partial serous investment, the tunica vaginalis. After the descent is completed, usually shortly before birth, but sometimes not until afterward, the tubular upper segment of the peritoneal sac closes normally during the early months of childhood. This closure takes place first in the vicinity of the internal abdominal ring and in the middle of the tube, passing upward toward the ring and downward to within a short distance of the sexual gland. The occluded portion of the vaginal process is later represented by a small fibrous band (ligamentum vaginale) that extends from the internal abdominal ring above, through the inguinal canal and for a variable distance down the spermatic cord, sometimes, although not commonly, as far as the tunica vaginalis. When the processus vaginalis fails to close, as it occasionally does in man and always in certain animals, as the rat, in which descent and retraction of the

testis periodically occur, the serous sac surrounding the testicle communicates throughout life with the peritoneal cavity, a condition favorable to the production of hernia. With the obliteration of the lumen of the processus vaginalis, an inguinal canal, in the sense of a distinct tube, disappears, the spermatic duct and associated vessels and nerves, that necessarily share in the migration of the sexual gland into the scrotum, passing between the muscular and fascial layers of the abdominal wall embedded in connective tissue. The remains of the shrunken genito-inguinal ligament, or gubernaculum, are represented by a fibro-muscular band, the scrotal ligament, that connects the lower end of the epididymis to the scrotal wall.

Etiology.—(A) Abnormal Descent.—Conditions which may have been regarded as causing arrest of testicle within the abdomen.

1. The mesorchium may be too long. This causes the testicle to hang too freely and it is prevented from engaging in the opening of the processus vaginalis.

2. Adhesions may be formed between the peritoneum of the mesorchium and the adjacent portion of the serous membrane generally, the result of an intra-uterine fœtal peritonitis.

3. Lack of action of the internal fibres of the cremaster.

4. The spermatic vessels may be too short.

5. Certain forms of hermaphroiditism.

6. Fusion of the testicles—synorchism.

Conditions causing arrest after the testicle has entered the canal:

1. Lack of development of inguinal canal, external ring, or one-half of the scrotum.

2. Deficiency or absence of lower attachments of the gubernaculum, or diminished activity of its muscular fibres.

3. Retraction by the action of the cremaster after the testicle has gained its normal position in the scrotum.

4. Pressure of a truss for an accompanying hernia preventing the onward passage of the testicle from the inguinal canal to the scrotum.

(B) *Maldescent or Ectopia.*—To gain a clear understanding of maldescent of the testicle, it is essential to appreciate the anatomy of the superficial fascia of the lower abdomen and groin. This consists of two layers, the superficial stratum called Camper's fascia and the deeper, Scarpa's fascia. The former passes downward in front of the spermatic cord and becomes continuous with the dartos of the anterior portion of the scrotum. The latter, Scarpia's fascia, descends internally over the pubis and fuses with Colles's fascia of the perineum, laterally it passes over Poupart's ligament and becomes continuous with the fascia lata of the thigh and is also attached along the margin of the rami of the ischium and pubis. These fascial planes are easily demonstrated at operation by lifting the lower angle of the wound and, passing one's fingers between the two layers, they easily enter the scrotum; but, inserting them behind the posterior layer they enter a space of loose tissue which at first may give one the impression of being in the upper part of the

scrotum, while actually the fingers are in the loose aerolar tissue of the upper and inner thigh. (Figs. 1 to 5.)

The most common form of maldescent is the inguino superficial occurring seventy-three times in our series of 537 cases. In this variety the testicle after escaping from the external ring instead of descending into the scrotum, passes upward and outward toward the anterior superior spine of the ilium and lies on the external oblique aponeurosis. The cause of this condition is hard to explain. In none have we found any remains of the gubernaculum, and it is only fair to assume that it had been ruptured and the testicle, having escaped from the external ring, finding its normal passage into the scrotum barred by some anomaly, takes the path of least resistance and comes to lie on the aponeurosis of the external oblique beneath the deep layer of the superficial fascia.

Dr. W. B. Coley believes that the most important and most frequent etiological factor in superficial type of maldescent lies in the presence of a congenital pouch of peritoneum upon the surface of the aponeurosis of the external oblique. In other words, in some unknown way the vaginal process of peritoneum instead of passing into the scrotum in the normal way has been diverted upward into the abnormal position upon the external oblique.

Doctor Coley has reported a case of bilocular sac in which one portion of the sac extended into the scrotum and the other upon the external oblique.

The second most common site for maldescent, in our experience, is the upper part of the thigh. This variety occurred thirteen times in our series. In all of these cases we were able to demonstrate the gubernaculum passing down ahead of the testicle beneath Scarpa's fascia and we feel its presence demonstrates its important bearing as an etiological factor. In some of these cases the testicle lay close to the perineum, but of course could not enter it by this route due to the attachment of both Scarpa's and Colles's fascia to the inner margin of the ramus and we cannot help but feel that some of the cases reported as maldescent of the perineal type are of this variety.

Maldescended testicles are also found at the root of the penis and in the perineum, but have not occurred in our series. One of the authors recalls having seen two of the former variety in the dispensary, but both were too young for operation and were subsequently lost sight of. Probably this variety is the beginning of a true perineal maldescent, for if we recall the fascial planes, previously described, in order for a testicle to reach the perineum, it must descend over the crest of the pubis, and then beneath Colles's fascia to the perineum. Whether these malpositions are caused by a complete rupture of the gubernaculum, and the testicle with nothing to guide it takes the path of least resistance, or whether this prolongation of the gubernaculum is hypertrophied and this influences the maldescent is impossible to state authoritatively. Our impression is that it is the gubernaculum which influences the maldescent to the perineum, for we cannot conceive of the testicle reaching that position by simply following the path of least resistance.

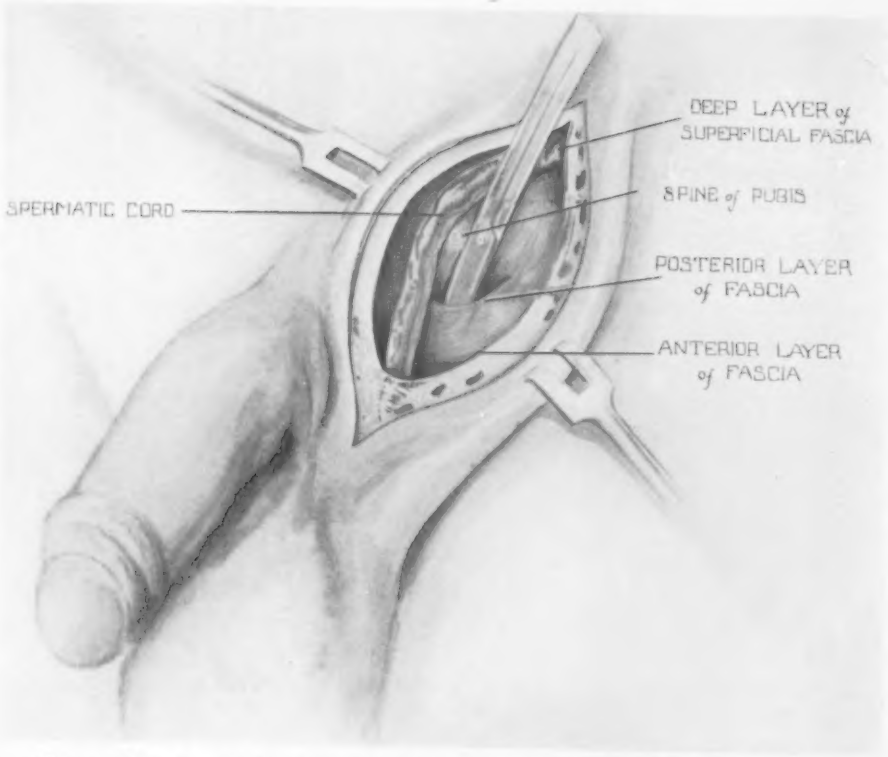

FIG. 1.—Dissection on the cadaver. Incision carried down through the skin and fascia exposing cord and fascial planes. Anterior layer becomes continuous with dartos of scrotum. Scissors passed behind posterior layer. Cord passes between two layers to scrotum.

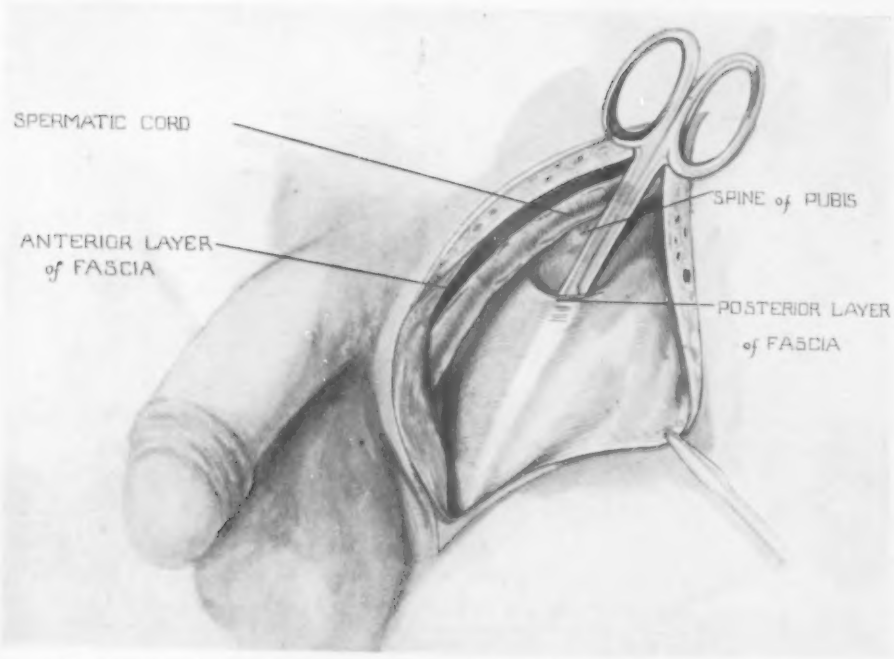

FIG. 2.—Skin incision enlarged, with scissors in loose areolar tissue beneath posterior plane.

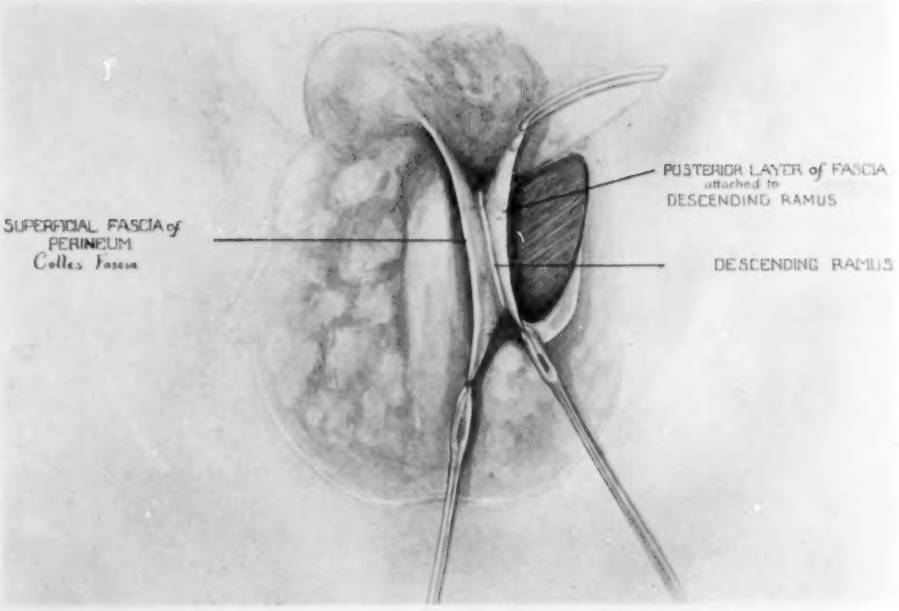

FIG. 3.—Showing attachment of posterior layer of fascia (Scarpa's fascia) and Colles' fascia to descending ramus. Obviously it is impossible for a testicle under this fascial plane to enter perineum.

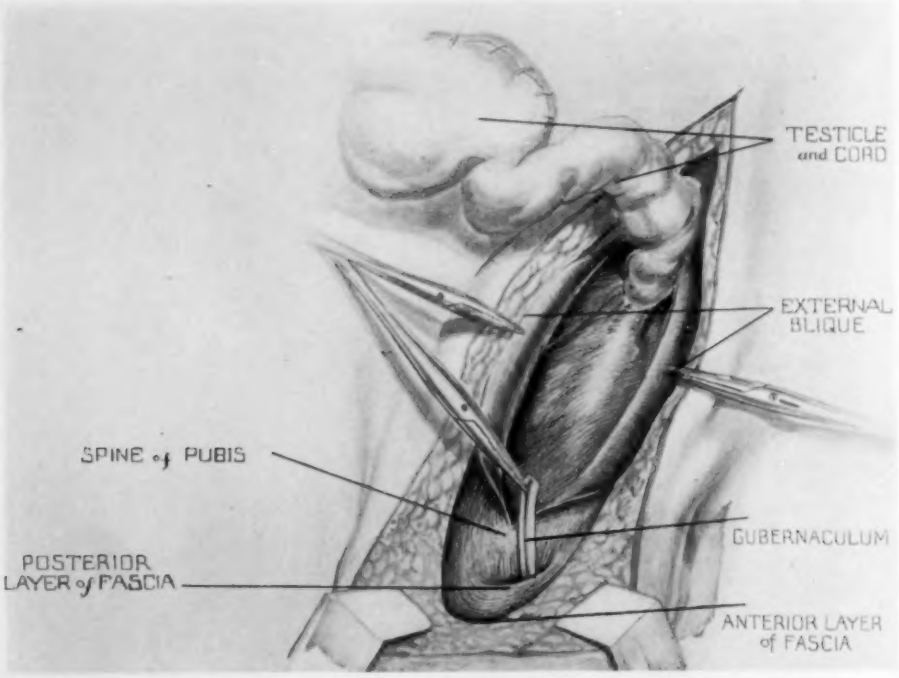

FIG. 4.—Illustrations from an actual case in which the gubernaculum lead beneath posterior fascial layer. Attachment of gubernaculum to testicle has been divided and latter reflected upon to the abdomen.

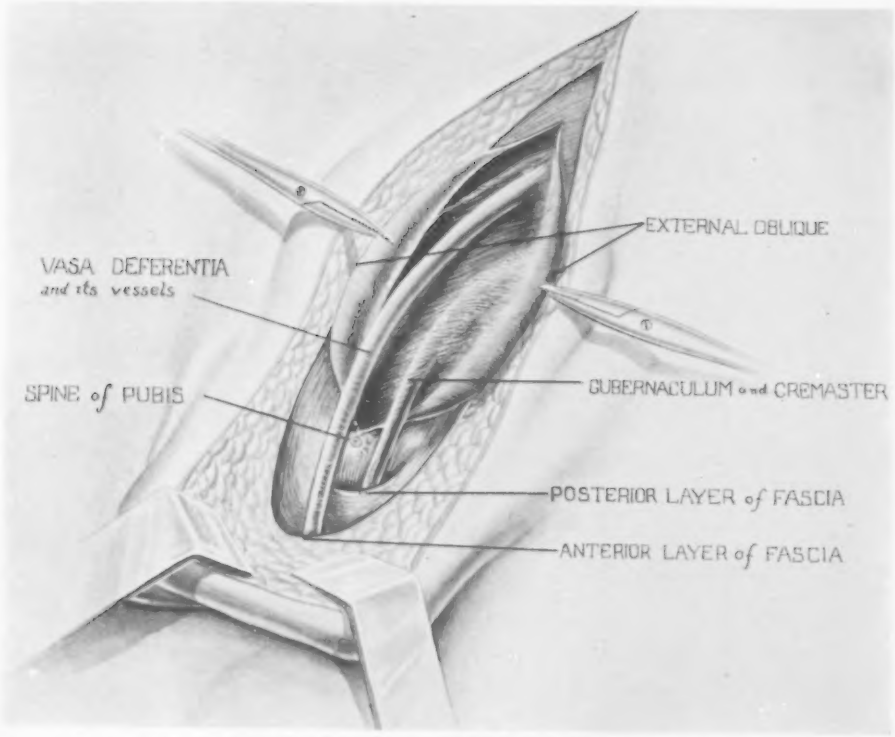

FIG. 5.—Testicle has been placed in scrotum between the two fascial planes. Gubernaculum passes behind posterior plane into thigh.

Pathology.—The undescended testicle is as a rule smaller than the normally situated organ and presents to the examining fingers a softer, flabbier, and less elastic feel. If examined microscopically before puberty, it shows a diminished number of spermatogenic tubules and the cells of these tubules may be degenerated. There is a corresponding increase in the thickness of the basement membrane and tunica albuginea and an increased amount of interlobular connective tissue. The interstitial cells or cells of Leydig, which are responsible for the internal secretion which governs the development of the secondary sex characteristics of the male, are increased in numbers. Probably, as stated by Caulk, these cells also degenerate as adult life is attained and a further diminution in size occurs which in some instances may result in an atrophic nodule of fibrous and fatty tissue.

The actual value of the undescended testicle, then, may be said to lie principally in its interstitial products and their influence on male secondary sexual development. For purposes of procreation it is probably utterly worthless despite the rare reported cases of fertility in double cryptorchids.

Atrophy occurs in a certain proportion of undescended testicles after operation. The degree of atrophy varies markedly and does not seem to be explainable by interference with the blood supply, for we note it in some cases where no disturbance of the cord vessels was caused at operation, and in those cases where division of the vessels (as described in the operative procedure) was practiced, it does not occur with any greater frequency. It must also be remembered that spontaneous atrophy may occur, though it is more commonly encountered after puberty than in childhood. That the atrophy of unoperated testes is due to malposition has never seemed to us a logical explanation. It seems more reasonable to assume that the inherent congenital defect in the organ which causes the characteristic histological changes also is responsible for its early atrophy, as any non-functionating glandular tissue tends to undergo similar changes.

Circulatory changes dependent upon a torsion of the spermatic vessels may occur in the normally situated testis. It is a far more frequent happening as Mixter states, in the undescended organ, since about half of the reported cases have been in abnormally placed testes and the proportion of arrested descent to normally situated testes is as one to five hundred.

In the past it has long been a question whether the abnormally placed testis is more prone to undergo malignant change than the one normally situated. Cunningham, taking the case records of a number of writers here and abroad, collected a total of 452 testicular tumors, of which 412 were developed in normally descended, and 40 in imperfectly descended testes, or a percentage of 10.3 normal to 1 abnormal. But as Lund has shown, the failure of proper descent of the testis occurs but once in 500 cases of normal descent, and he concludes, with reason, that the undescended organ is vastly more susceptible to malignant degeneration than one normally placed.

Trauma has been advocated as one of the causative factors in the development of malignant testicular tumors. In a series of 78 personally observed

cases, W. B. Coley elicited a history of trauma in about 33 per cent. The fact that in the majority of cases of maldescent, the testis is to be found in the inguinal canal may be seen to favor the theory that trauma plays a rôle in development of malignancy, since testes in the canal are obviously more liable to trauma than the scrotal or intra-abdominal variety.

Moreover, it seems that malignant degeneration of the undescended testis is in keeping with the well-recognized observation that malignant tumors develop with frequency in highly specialized organs which are congenitally defective and in which the growth rate and period of maturity are at variance with the normal. Thus we ascribe the higher rate of malignant changes in undescended testes, not to the mere circumstance of their abnormal position, but to an inherent cellular abnormality which also is responsible for the other histological differences noted previously. It is also suggestive that malignant changes seldom occur before the onset of puberty, but are most frequent during the period of greatest sexual life. At a time when cellular changes are taking place in accordance with functional demands, it seems logical that metaplasia might occur more frequently in a defective organ than in a normal one.

Diagnosis.—The diagnosis of maldescent of the testis is not difficult since it at once suggests itself to the examiner, who on palpating the scrotum finds one, or both testes absent. It is important, however, not to overlook the fact that in young boys the cremasteric reflex is so active that the testis may retreat within the external inguinal opening and give the examiner the impression of a testis that has failed to descend. By pressure along the canal from above downward and inward the testis pulled up by the cremasteric reflex can be restored to its normal scrotal position, whereas the true undescended organ cannot. The absence of a testicle in the scrotum and at the same time the presence of an ovoid elastic, movable mass in the course of the inguinal canal is diagnostic. Rarely no such mass can be palpated and in these cases the organ is truly abdominal.

Ectopic testis may be diagnosed by finding the characteristic mass in one of the following situations: Beneath the fascia and overlying the external oblique aponeurosis, at the root of the penis, beneath the fascia of the thigh, or exceedingly rarely in the perineum. If it lies just outside the external ring we ascertain, if possible, whether it is directed toward the scrotum or thigh. A little experience makes this comparatively easy as gentle downward pressure will usually show us which path it will choose.

Ectopia of the superficial inguinal type is the hardest to diagnose, but frequently the sac with the contained testicle can be felt lying superficial to the aponeurosis of the external oblique between the external ring and the anterior superior spine.

It should be emphasized that while the undescended testicle is almost invariably associated with congenital inguinal hernia, such a hernia is very frequently not palpable or recognizable prior to operation. In our experience,

however, a hernia sac is almost invariably found at operation in association with maldescent of the testis.

It is important to recognize two types of endocrine dyscrasias with which there may be found an associated abnormal descent of the testis. These are the Froelich type, and the condition known as congenital hypogonadism. In both of these clinical entities there are profound structural and anatomical departures from normal.

The Froelich, or hypopituitary type is characterized by being, as a rule, below normal stature, uniformly adipose, often of low mentality and sluggish in activity. The carbohydrate metabolism is uniformly above normal and the pituitary is markedly enlarged or very small. As is implied in the name, the condition is due to a lack of the internal secretion of the pituitary gland.

Congenital hypogonadism is associated with a normal mentality, stature being normal, or slightly above, the adiposity confined to selected parts of the body rather than generalized obesity. The testes in both these conditions are markedly atrophic and external genitalia are likewise underdeveloped.

The necessity for recognition of the presence of one or the other of these abnormal types lies in the obvious fact that prognosis as to the end result from a developmental standpoint should always be most guarded. It is quite impossible to expect the operation to affect the underlying endocrine imbalance favorably and parents should be assured of this to avoid further disappointment. The indications for operation are still those of the case of uncomplicated maldescent of the testis, namely, the cure of the frequently associated hernia, and the avoidance of the increased liability of the organ to undergo malignant change.

Incidence.—This series comprises 537 operations in 482 patients under seventeen years of age, performed at the Hospital for Ruptured and Crippled from 1891 to 1924, 239 occurred on the right side, 188 on the left side and 55 were double.†

Under 4 years	8	11 years	36
4 years	32	12 years	45
5 years	41	13 years	36
6 years	49	14 years	25
7 years	42	15 years	7
8 years	53	16 years	8
9 years	59	Not stated	1
10 years	40		
		Total	482

Indications for Operation.—We feel that the most suitable age to operate is between eight and twelve years. This gives the testicle a good chance to descend voluntarily if it will, it is larger and easier to manipulate and the structures are more easily identified than in younger patients. Also the organ

† We are indebted to Drs. W. B. Coley, J. B. Walker, J. P. Hoguet and other members of the Attending Staff for the privilege of studying these cases.

has been placed in its normal position before the changes which come with puberty occur.

If the undescended or maldescended testicle is accompanied by a large hernia, we feel an earlier operation is imperative, as naturally retention of the hernia by a truss is sure to exert pressure on an already underdeveloped organ, and would also prevent any tendency to normal descent. Truss treatment is therefore contra-indicated. In maldescent, especially when the testis is directed into the thigh instead of the scrotum, we usually advise operation earlier, as further descent does not aid the testicle in reaching the scrotum.

Location of testicle before operation: We regret that our statistics on this classification are incomplete, as we only have accurate data in 210 of the 537 cases, which is as follows: Abdomen 17, inguinal canal 83, external ring 24, inguino superficial 73, thigh 13. We believe it is fair to assume that in the majority of the cases in which the position was not stated the testicle either lay in the canal or at the external ring and that most of the more unusual locations were noted.

Operative Technic.—The usual skin incision as for a simple hernia is employed, save that it is carried downward well over the spine of the pubis. In carrying the incision through the superficial fascia it is important to realize that we may be dealing with a sac of the superficial inguinal type, which after its emergence from the external ring turns upward toward the anterior superior spine and lies on the aponeurosis of the external oblique just beneath the deep layer of the superficial fascia. If this possibility is not borne in mind a hasty incision may result in damage to the testicle or vas. In cases where the testicle lies in the canal and has never escaped through the external ring, the latter may be very small and difficult to identify. Rather than spend too much time in trying to identify it, we believe it simpler to make an incision in the external oblique from above downward, terminating immediately over the spine, which is the point where the external ring ought to be. Having reflected the aponeurosis and exposed the inguinal canal, we follow the gubernaculum to its termination and decide whether it leads into the scrotum or beneath Scarpa's fascia into the thigh. We cannot emphasize this point too strongly, for in spite of all the excellent literature on the operative treatment of undescended testicles, we have not seen this possibility dwelt upon, and what is more evident to the occasional operator on this condition than to assume that by following the gubernaculum, he must place the testicle in the scrotum. Having definitely determined the direction of the gubernaculum, the next step is to recognize the two layers of fascia by placing retractors in the lower angle of the wound and inserting two fingers between the two layers and lift up the drapings to assure oneself that the fingers are in the scrotum. A good-sized pouch is made and packed firmly with gauze; this stops all bleeding and prevents the pouch from contracting.

The cremaster is now divided in the direction of its fibres and the sac, vessels and testicle delivered, the vessels and the testicle lying apparently

within the sac. The latter is now opened near the internal ring, but sufficiently distant from it, so that in case the sac is torn during the separation of the vessels, it will be readily recognized before the tear has extended within the ring. By making gentle traction on the testicle, either by means of a clamp attached to the gubernaculum or by surrounding it with gauze, the sac and vessels are put slightly on the stretch. This tension brings out the natural cleavage planes between the sac and the vas and the vessels which are spread out on the posterior surface of the sac. Clamps are placed on either side of the opening in the sac the vessels and vas are separated from it by displacing them posteriorly, working with blunt-pointed scissors in the areolar tissue which lies between the sac and infundibuliform layer of fascia, the latter uniting the cord structures to the sac. Sometimes this separation is simple, at other times quite difficult, and we believe it is the most complicated part of the operation. It is important to be sure one is working within the infundibularform layer of fascia, and if the sac does begin to tear, to recognize it immediately. As W. B. Coley has so aptly described it, " when it tears, it tears like tissue paper." Having cut across the sac, the next and most important step is the separation of the upper end from the vessels. This procedure is simplified by putting a blunt retractor within the internal ring and lifting it upward, thereby getting a higher separation and breaking up all the adhesions which exist between the vessels and the peritoneum anteriorly and vessels and posterior abdominal wall posteriorly. The sac is now transfixed and ligated and the redundancy excised. This procedure cures the hernia. The direction which the vessels and the vas take from the internal ring is now readily demonstrated. The former extending almost directly upward, the latter passing backward, downward and inward toward the pelvis.

We are convinced that the spermatic vessels are one of the chief offenders in the shortening of the cord and as the vas is practically always of sufficient length we see no occasion to try and lengthen it by causing it to emerge internal to the deep epigastric vessels. Naturally this procedure has no effect on the lengthening of the spermatic vessels because they already descend from the aorta and vena cava in a nearly straight line.

In the simple cases the separation of the adhesions about the internal ring will give sufficient length to the cord to place the testicle well toward the bottom of the scrotum without tension. In the others the various fascial bands about the cord will have to be divided, and in the more severe cases the vessels are manifestly too short and must be divided as recommended by Bevan. As previously stated, the vas is almost invariably of sufficient length and frequently we see it dipping down well toward the bottom of the sac and then turning upward to meet the testicle. We feel if the vessels are to be divided this decision must be arrived at before too many fascial bands have been cut, lest in our enthusiasm we may injure the tiny artery which accompanies the vas. Having obtained by one means or another, the sufficient lengthening of the cord, we may form a new tunica by suturing the lower

end of the sac about the testicle. This is a refinement which we do not consider essential. Sometimes it may facilitate the subsequent formation of a hydrocele. Some that advocate it claim that if the testicle is not covered with a serous layer, the fact that it lies bare in a cavity composed of a certain amount of connective tissue, may interfere with its subsequent development. Both these objections we believe are chiefly theoretical and we do whichever seems indicated in the individual case.

The gauze which was used to distend the scrotum is now removed and replaced by the testicle. We do not advocate suturing the testicle to the bottom of the scrotum, for we firmly believe that if it is necessary to mechanically fix it there we have defeated the object which we had hoped to attain, *i.e.*, bringing the testicle into the scrotum without tension. For the same reason we do not feel it essential to suture the upper opening into the scrotum, but see no objection to it if one prefers. The cord is not transplanted and the wound is closed as in the usual hernia operation. Before the dressing is fixed, we strongly advise palpating the scrotum to reassure ourselves that the testicle lies free in the place where nature intended it should be.

End Results.—Before stating our end results, we feel it only fair to explain that many results have been written as satisfactory without further observation as to location or size of testicle, and we have classified these under the heading "not stated."

Location of testicle after operation:

Not traced	120	Outside external ring	77
Not stated	127	Upper scrotum	64
Not palpable	13	Scrotum	114
Inguinal canal	13	Thigh	9
			537

Assuming that from the standpoint of location after operation a testicle in the scrotum or upper scrotum was satisfactory, excluding the not traced ones, gives us a 40 per cent. satisfactory result. If we also exclude the group of not stated cases we have a 60 per cent. satisfactory result. It seems to us fair to assume that the percentage of satisfactory results lies somewhere between these two probably around 50 per cent.

Size of testicle after operation: In this classification our statistics are very incomplete and the results very unsatisfactory.

Not traced	120
Not stated	328
Not palpable	13
Atrophic	47
Normal	29
	537

This gives our percentage of normal testicles, including the not traced, as 7 per cent. By excluding the not traced and the not stated, which is a most liberal interpretation, we get 31 per cent. of testicles normal in size. We

are sure this is too high and we hope the 7 per cent. is too low, probably the true proportion being about 15 per cent.

CONCLUSIONS

(1) In practically all cases of undescended testicle there is a patent funicular process in which a definite hernia is almost certain to develop in later years.

(2) Any testicle that does not lie in its normal position is more subject to trauma and more liable to malignant degeneration. Statistics show that the incidence of malignant changes is fifty times greater in the imperfectly descended testicle.

(3) Every growing boy is prone to an inferiority complex which may prey upon his mind if his testicles are not normally situated.

(4) The chief value of the imperfectly descended testicle lies in its internal secretory function, and for this reason castration is not to be recommended and should never be performed in cases of double maldescent.

(5) A thorough understanding of the fascial planes of the groin is essential to be sure that the testicle is placed in its proper position. In our series we found nine cases after operation in which examination revealed the testicle in the thigh rather than in the scrotum. Faulty direction of the gubernaculum is the usual cause of this error.

(6) The activity of the cremasteric reflex should always be borne in mind in examining patients suspected of having an undescended testicle.

(7) The ideal age for operative interference is between eight and twelve years. The presence of a large hernia is an indication at any age since a truss should never be worn.

(8) Prognosis should be especially guarded in individuals of either the Froelich type of hypopituitary adiposity or the clinical type of hypogonadism.

(9) In our series of 537 operations, satisfactory results as to the location of the testis were obtained in about 50 per cent. As regards the size of the testicle, satisfactory results were obtained in about 15 per cent. Our experience leads us to believe that except in rare instances an atrophic testicle when placed in the scrotum does not continue to develop normally.

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METASTATIC INTRAMUSCULAR GONOCOCCAL ABSCESS*

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Metastatic phenomena in gonorrhœa in contradistinction to the local complications caused by extension through continuity or lymphatic carriage from the original point of infection were demonstrated by pure culture in the last decade of the 19th century following the discovery of the gonococcus by Neisser [1] in 1879 and its cultivation by Bumm [2] in 1885. The connective tissue has been a relatively fertile locus for metastatic invasion of the gonococcus, more especially the joints and tendon sheaths. Periostitis and osteomyelitis due to Neisserian infections have also been described. Subcutaneous abscesses of gonorrhœal origin have been infrequently reported by various authors: Lang and Paltauf,[3] Sahli,[4] Korvitz,[5] Hochmann,[6] Almkvist,[7] Cassel,[8] Dwyer,[9] Kirmse,[10] and others. The early experimental work of Wertheim,[11] confirmed by Steinschneider,[12] both of whom were unable to cause suppuration in the subcutaneous area by injection of gonococci in pure culture, receives an interesting commentary in the report of Fulton,[13] who found a furuncle in the subcutaneous tissue of the arm massively infected with a genito-urinary surgeon's unsterilized bistoury. Muscles, though not immune, have been involved with the rarity to be expected in view of their high resistance to other forms of infection.

Four fairly distinct classes of primary gonorrhœal myositis, exclusive of periarthritic inflammation, are distinguishable in the literature. One a transient benign type as in Sach's [14] case in which both sterno-cleido-mastoid and trapezius muscles were painful and swollen. Subsidence occurred in less than two weeks without observable sequelæ. Cappelli [15] and others have reported similar cases. Selenew's [16] case and Eulenburg's quoted by Kienboeck [17] typifies the second or atrophic form. Eulenburg's patient, a man twenty-four years old, with a gonococcal endocarditis, had following an arthritis of both knees and the right elbow a rapidly progressive atrophy of the right deltoid, in direct sequence with an arthritis of the shoulder and of the pectoralis, serratus, latissimus, and trapezius muscles. Shortly afterward, atrophy of the homologous muscles of the left side was apparent. Such cases may conceivably be due to the frequently invoked gonotoxin. A third class for which the term gonorrhœal sclerotic myositis was proposed by Eichhorst is represented by four cases: Two reported by Rona [18] which practically are duplicates; both in men aged twenty-seven, occurring during the course of a chronic urethritis, heralded by pain a few days before the appearance of a tender area of induration in the middle of the anterior surface of the thigh, covered by normal skin. In his first case the induration was the size of a

* Read before the Fayette County (Ky.) Medical Society, June 15, 1926.

dollar and persisted for weeks in spite of hot compresses and massage. In the second the tender infiltration was about the size of the palm and also resisted local treatment so that tenderness was present even a year later. Polyarthritis appeared nineteen months after the onset of the myositis. Both were thought by the author to be associated with the fascia lata and underlying muscles. Eichhorst's [19] case of a man fifty-six years old, who in the fourth week of an acute gonorrhœal urethritis, noticed pain in the external aspect of the right thigh a little above the middle, followed in a few days by palpable induration, hard as cartilage, four by eight centimetres in size, skin normal. This was followed in two weeks by arthritis of the wrist. And the last of this class reported by Cumston [20] in a man twenty-seven years old. Two weeks after the onset of an acute gonorrhœa the patient suffered from fever, malaise, and pain in the right biceps muscle. Five days later swelling appeared and persisted for six weeks. The mass was circumscribed, hard and tender.

All of the above types remain on a purely clinical level and are apt to prove somewhat difficult of demonstration. The fourth, with which this paper is more directly concerned, is the purulent form.

Recently a case came under observation of suppurative myositis following an acute exacerbation of a chronic urethritis and endocervicitis from which at operation Gram-negative diplococci were obtained proven by the methods referred to below as being gonococcal.

Harris and Haskell [21] in 1904 were unable to find in a survey of the literature any cases which they could regard as more than tentatively established as gonococcal intramuscular abscesses, Ware [22] in 1901 reviewed the reported cases as did Schwetz [23] in 1906 and Norris [24] in 1913.

In the present review of the literature numerous cases of suspected gonococcal abscess have been found, none, however, proven according to present bacteriological criteria. Among those which are probably primarily intramuscular the reported laboratory findings vary from smears and cultures on properly enriched media or plain agar or bouillon, to no data or no details. A number though intramuscular are almost certainly due to lymphatic extension from a neighboring arthritis and cannot be considered metastatic. Others are apparently cases in which the intramuscular abscess is but one phase of a generalized pyæmia or an infarction episode in a malignant endocarditis.

To the group of what may be called primary intramuscular abscesses belong the following cases:

1. Samberger.[25] Male, thirty-five. An arthritis of the knee in the second month of a urethritis was complicated by a pain in the arm and a nut-sized swelling in the muscles of the posterior axillary fold. The seropurulent exudate obtained on incision yielded gonococci proven by smear and culture. (No data.)

2. Harris and Haskell.[21] Female, thirty-four. The patient had had leucorrhœa for years and a mass in the lumbosacral area for four months and another in the calf for one month prior to admission. Both were the size of an egg. At operation the erector spinæ and gastrognemius and soleus muscles were found involved. The cream-like pus showed Gram-negative diplococci. No growth on bouillon, typical colonies on

plain agar. Transplants to hydrocoele—fluid agar gave fair growth. Subcultures from hydrocoele agar failed to take on plain agar, Loeffler's blood serum, bouillon, or potato.

3. Busquet et Bichelonne.[26] Male, twenty-three. Hæmatoma in the right calf one year prior to present illness. A urethritis was followed in one week by extreme pain at the site of the old hæmatoma. One hundred cubic centimetres of dark blood and thick pus were evacuated from beneath the soleus and biceps femoris. Leishman stain showed gonococci in smear. A growth of organisms was obtained on gelatine enriched with pleuritic transudate; no growth on potato, gelatine, or bouillon.

4. Farani.[27] Female, nine. Some time after the onset of a vulvovaginitis the patient experienced pain in the kidney region succeeded by perceptible swelling and flexion of the hip. A diagnosis of perirenal abscess was made and exploration instituted. An abscess in the lumbar branch of the psoas muscle was opened and drained. Gram-negative diplococci were found in the pus in true culture. (No details.)

5. Ware.[22] Male, thirty-five. A painful swelling the size of a walnut appeared in the latissimus dorsi near the posterior axillary fold, preceded by urethritis and arthritis of the left knee. On incision the muscle was found to be sodden, friable, gray. No pus, though there was free ooze of turbid serum. An excised muscle segment showed numerous diplococci embedded in the fasciculi. A smear of the exudate showed Gram-negative diplococci. Cultures on sugar agar and bouillon were negative.

6. Schlesinger.[28] Male, twenty-one. Ten days after a gonorrhœal urethritis and cellulitis of right forearm, infiltration appeared in the right posterior tibial muscle. Thick reddish-brown pus obtained from the necrotic muscle showed gonococci on microscopic examination.

7. Servel.[29] Male, forty-four. Case XV, in which a mass, the size of an almond and hard was found in the left masseter. Pain precluded any motion. Sterile puncture yielded Gram-negative diplococci, mononuclear and polymorphonuclear cells.

Secondary intramuscular abscesses extending from a neighboring arthritic focus are instanced by the cases of:

1. Yevdokimov.[30] Male, twenty-nine. Swelling in the left calf the size of a child's fist following an arthritis of the left ankle and knee due to the last of a series of frequently recurring Neisserian infections. The seropurulent material aspirated from the swelling showed no organism on microscopic examination, but many pus cells. Blood cultures and cultures of the pus on ascitic agar, ascitic gelatine, and bouillon were negative. A smear of blood, taken from the finger, showed Gram-negative diplococci.

2. Desplats et Desplats.[31] Male, nineteen. About two weeks after a gonorrhœal infection, the patient had an arthritis of the shoulder. Six days later an inflammatory zone appeared in the biceps. Gonococci and streptococci were demonstrated in the pus. (No laboratory details.)

3. Kloeppel.[32] Female, twenty-six. Vulvovaginitis, urethritis, and endocervicitis with a heavy leucorrhœal discharge had existed for three weeks. Arthritis of the right ankle followed by an infection ascending to the mid-leg and localization of an abscess in the anterior tibial muscle. Twenty cubic centimetres of pus were obtained which gave pure culture of gonococci. (No details.)

4. Farani.[27] Case I. A post-abortion exacerbation of a chronic gonorrhœa with pain, dysfunction, and multiple small intramuscular abcesses about shoulder. Pus gave positive culture.

Malignant endocarditis or pyæmia account for the following secondary cases:

1. Wynn.[33] Male, nineteen. Abscesses over the right hip and in both calves followed an urethritis. Blood cultures on blood agar showed gonococci, fluid from the arthritis of knee also gave pure culture. Pus from the abscesses developed mixed growth

of B. coli and gonococci. Exitus twenty-four days after admission. Autopsy disclosed an early endocarditis from the vegetations of which diplococci were obtained on smear. Culture negative.

2. WYNN. Male, twenty-four. Patient after a protracted course and varied surgical interference disclosed at autopsy suppurative nephritis, two large pelvic abscesses, seminal vesiculitis and numerous small subcutaneous and intramuscular abscesses in the chest wall. Films and blood agar cultures from the suppurative foci showed the presence of a mixed infection with B. coli, staphylococci, and gonococci. Blood from the heart on plain agar slopes developed a pure culture of gonococci.

3. STRONG.[34] Soldier admitted January 15, 1904, with chronic gonorrhœa and abscesses involving the left extensor carpi ulnaris and extensor digiti quinti muscles. Opened January 21, with escape of forty-five cubic centimetres of pus. Later, abscesses were opened at the border of the right sterno-mastoid and at the junction of the right deltoid and pectoralis muscles. A typical growth was obtained in forty-eight hours on blood serum. Many gonococci were found in the smear. The biceps and the flexors of the right thigh were indurated. (No details of smears or cultures.)

A miscellaneous group more or less pertinent to intramuscular gonococcal abscess has been found in the course of the bibliographical research.

To this belong Iwanoff's case, quoted by Von Hoffmann,[35] of gonorrhœal "endometritis" with a small abscess in the wall of the left ventricle and one in the parenchyma of one kidney in which smears showed cocci believed to be micrococci gonorrhœæ; that of Councilman[18] with myocarditis, pericarditis, arthritis, and urethritis caused by a Gram-negative coccus; that reported by Serafini[37] of an abscess in the internal and external oblique muscles due to an antecedent epididymal abscess; Budjwid's[38] report of multiple abscesses, the intramuscular character of which has been questioned by Young[39] and validly objected to by Harris and Haskell[21] on the grounds of their location; Power's[40] case of diffuse gonococcus infection of the entire upper extremity originating almost certainly in an infected elbow-joint. What pus was obtained here, came, from below and in front of the external condyle, leaving the exact location of suppuration indefinite as to its subcutaneous or intramuscular position. A unique instance of gonococcal abscess has been described by Kerassatis[41] whose patient with each recrudescence of a specific urethritis, complained of pain behind the right ear. Under observation a fluctuating inflammatory mass overlay the right mastoid region. Some intracellular organisms resembling gonococci, were found on smear of the thick gray pus evacuated at incision. Whether this case was subcutaneous or had its origin in the upper extremity of the sterno-mastoid muscle is not clear, though the former assumption is much the more probable. It seems unlikely that it should have been an extension from a possibly involved temporo-maxillary joint. Cases of subcutaneous abscesses associated with gonococcal arthritis are reported by Dufour,[42] Klippel et Rachet,[43] Schwetz,[28] and Young.[39] Chauffard and Fiessinger[44] give a description of a case of probable extension of a purulent process from an arthritis along facial planes, between biceps and brachialis muscles.

The following case referred by Dr. Maurice Davis is presented because of its undoubted gonococcal metastatic nature:

Mrs. H. W., a white woman of twenty-five, married, first seen March 25, 1926, on account of pain and swelling of right forearm.

Past History.—In 1922, following curettage for an incomplete, probably self induced, abortion, the patient had an attack of acute pelvic inflammation the results of which necessitated a double salpingectomy and right oophorectomy on May 13, 1925. History of the onset of the Neisserian infection is vague, but it probably antedates the abortion by some years. Dysuria and leucorrhœa have recurred intermittently for which the patient has had desultory treatment. About ten days before onset of the present illness

burning on urination and yellowish vaginal discharge reappeared. Treatment consisted of topical applications of mercurochrome and silver nitrate, without marked amelioration of symptoms.

Present Illness.—Onset March 16, 1926, some ten days after recurrence of urethritis and endocervicitis, with toothache-like pain in dorsum of right mid forearm. Pain was constant and gradually increasing in severity. Forty-eight hours later some puffiness of the mid forearm was noticed. No chill or sweats. No vomiting. Patient has felt feverish during the last few days. Codeine given in rather large doses has failed to afford relief from the throbbing pain. The puffiness first noticed has increased to a definite swelling.

Physical Examination.—Temperature, 101.4; pulse, 104; respiration, 22.

General Appearance.—That of a well nourished and well developed young white woman, lying in bed complaining of exquisite pain and swelling of the right forearm.

The ureteral orifice was reddened, no pus on stripping, cervical os inflamed. Stringy muco-purulent discharge, otherwise general and regional examinations negative, except as noted in following history.

Local Examination.—On the dorso-lateral aspect of the mid third of the right forearm is a swelling four by six centimetres, raised about one centimetre above the surface, oval, equidistant from radial styloid and external epicondyle, tender to touch, painful. Skin over swelling normal, though slight local heat is appreciable. Active flexion and extension of the wrist and elbow unrestricted, but painful at point of swelling. Pronation and supination normal. Ring and middle fingers held in semiflexion; they can not be fully extended actively, but can be passively without pain. Pseudo fluctuation as in a lipoma is noted.

Urinalysis.—Amber, cloudy, acid, specific gravity, 1.010, trace of albumin, sugar and acetone negative. Few pus and epithelial cells, many red blood cells.

Blood: Hæmoglobin, 65; red blood cells, 4,000,000; white blood cells, 12,640; polymorphonuclears, 75; small lymphocytes, 20; large lymphocytes, 3; large mononuclears, 1; Transitionals, 1.

Urethral and endocervical smears show typical Gram-negative coffee-bean-shaped diplococci.

Operation.—March 25, 1926. Light ether anæsthesia. Picric acid skin preparation. Incision was made over point of greatest prominence where suggestion of fluctuation was present. No œdema of subcutaneous tissue or muscles noted. Blunt dissection with finger through belly of extensor digitorum communis, which was found to be of normal color but friable in its deeper portion. About two cubic centimetres of thick creamy white pus was encountered just before reaching the radius. Bone felt normal to mediate palpation with clamp and smooth to finger. No tendons noted in field. Wound packed with iodoform gauze. Dry dressing applied.

Laboratory examination of pus obtained at operation showed Gram-negative intracellular diplococci, identical in morphology with those obtained from urethra and cervix. Culture of the pus on blood agar slants under reduced oxygen tension, produced in twenty-four hours typical dewdrop colonies which later became about 0.5 to 1 millimeter in diameter, gray, glossy, translucent, round bordered with scalloped edges. Subcultures on dextrose produced fermentation. Maltose was not affected. Seeding on plain agar and bouillon remained sterile.

Post-operative Notes.—Pulse, temperature and respiration fell to normal within three days. Wet dressings were applied and wound was dressed and repacked every other day and irrigated at first with mercurochrome and later with argyrol. Rather marked pitting œdema appeared in upper forearm and elbow on the third post-operative day, most marked about external condyle. This gradually subsided in about a week. For about one month following this œdema the patient was unable to fully extend the forearm. The fingers were held in semi-flexion for some three weeks after operation. Three weeks after operation the patient complained of severe pain in left lower quadrant

requiring codeine for relief. Pelvic examination at this time disclosed a slightly enlarged and boggy cervix and fundus. Purulent discharge still noted, though inflammation had largely subsided. Fornices and cul-de-sac clear. One week after operation treatment of the urethritis and endocervicitis was resumed and the condition was soon greatly improved. Pains in the left lower quadrant recur with decreasing severity every few days. Wound healed in thirty-five days. Six weeks after operation all movements of fingers, wrist, and elbow were normal.

Comment.—Rothe [45] in 1908, and Elser and Huntoon [46] in the following year, made possible through their experimental work the differential identification of the gonococcus from the remainder of the Neissereæ by means of fermentation tests. The technic of culturing the gonococcus by the method of lowered oxygen tension first reported by Wherry and Oliver,[47] and recently elaborated and popularized by Swartz,[48] has greatly facilitated the isolation of suspected cocci. The evidence of the Gram stain can be considered as no more than presumptive of the presence of the gonococcus, especially in extragenital lesions. Cultural methods are necessary to diagnosis and the final proof devolves on the relatively simple fermentation tests or on immunological reactions. However, the dictum that growth on ordinary media precludes the presence of gonococci cannot be rigidly maintained as pointed out by Johnson and Hill [49] as a number of observers have isolated what they considered gonococci on such media.

As mentioned above none of the seven collected cases of probable primary metastatic intramuscular abscess complies with the present requisites of identification. Four cases (21, 25, 26, 27) are supported by both smear and culture; one (22) by smear culture negative due to improper media; the other two (28, 29) by smear only. In spite of the absence of complete data all of these seven cases should be considered as true instances of gonococcal purulent myositis. The two cases of Rona and that of Eichhorst were thought by Ware to be the only authentic cases reported; while Harris and Haskell felt that the case of Ware was the only one even partially substantiated up to the time of their respective reviews. Dufour's [42] second case of an abscess in the muscles of the arm seems to be excluded from this series as the organisms grew in colonies described as being 2 or 3 millimeters in diameter. Gonococcic colonies do not grow to this size.

Summary.—Seven cases of probable but unproven gonococcic abscesses in muscle tissue are abstracted from the literature and a case due to a transient gonococcæmia is presented with confirmatory bacteriological data. We wish here to make acknowledgment of the kind assistance of Dr. E. S. Maxwell, and his technician, Miss McKenna, in carrying out the bacteriological work.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held May 12, 1926

The President, Dr. Walton Martin, in the Chair

BRAIN ABSCESS

Dr. Charles A. Elsberg presented a boy, fourteen years of age, who had had sinus trouble for years. Three weeks before the operation he had an otitis followed by mastoiditis, for which he was operated upon. For one week he had gradually increasing headache with drowsiness, loss of flesh and fever.

At the examination he was found to have distinct signs of a right cerebellar lesion, although the fundi were normal.

March 6, 1926, under local anæsthesia, a button of bone was removed over the right cerebellar hemisphere, the dura incised and the right hemisphere aspirated. Considerable thin pus, containing hæmolytic streptococci, was found, and the abscess drained.

After the operation the temperature rapidly fell to normal, and he made a prompt and uneventful recovery, his wound being entirely healed by the end of April.

Doctor Elsberg presented a second case in the person of a patient, seventeen years of age, who one month after an operation for pyopneumothorax, developed severe headache, convulsive twitchings on the left side of the body and increasing papillœdema. Through a trephine opening over the right temporo-parietal region, a brain abscess, 4 centimetres below the surface of the brain, was opened and drained—at least three ounces of pus being evacuated. The patient improved for a few days, but the papillœdema became more marked and paresis of the left arm and leg appeared. As the abscess was one without a lining membrane, a second operation was performed. Considerable bone was rongeured away, the dura widely opened, and the abscess cavity laid wide open by an incision 2 to 3 inches long through the brain tissue. Two Carrel tubes were inserted into the cavity, around which gauze packings were introduced, so that the cavity was held wide open. Daily irrigations with Dakin solution were given. Improvement was rapid after this second operation—the papillœdema receded completely, the weakness of the left upper and lower limb disappeared, and the patient was discharged from the hospital after six weeks, apparently well, free from all signs of neurological disturbance. One month later, a small superficial abscess in the bulging scar was incised and drained, after which the wound healed, the large cerebral hernia that had existed, rapidly receded, and the patient had remained well, excepting for a few convulsive seizures which are undoubtedly due to the large cicatrix in the brain tissue. The operations were performed over one year ago. The pus from all of the abscesses contained staphylococcus aureus in pure culture. This is the first case of a brain abscess secondary to pulmonary suppuration that has recovered in the experience of the speaker, and he believes that the satisfactory result was due to the wide incision and drainage of the abscess, and the daily irrigations with Dakin solution.

The reporter remarked that the most favorable results in abscess of the brain are obtained when the abscess has a well-marked lining membrane, but in a series of six cases of brain abscess without any lining membrane, the abscess was washed out daily with Dakin solution and all of the patients recovered. The speaker referred to the importance of a number of technical details in the surgical treatment of abscess of the brain and illustrated the technic he follows by a series of lantern slides.

Doctor Elsberg then presented a girl, fourteen years of age, who had eight weeks before scarlet fever. Four weeks after the attack she complained of pain in the right ear, but nothing abnormal could be found in the ear. She then had several generalized convulsions; she became stuporous with involuntary urination.

On physical examination she was found to have double choked disc of 3-diopters with hemorrhages. There was a marked weakness of the lower branches of the left face; supernuclear in type. There was some rigidity of the neck and Kernig.

She was operated on soon after admission. The diagnosis of brain abscess was made and through a small incision in the right temporal region, a button of bone was removed and the brain punctured. At a depth of 3 cm. pus was obtained. The abscess was opened and drained and she has made a very satisfactory recovery. She is now presented one year after operation perfectly well. The culture showed that the pus contained streptococci in long chains.

CHONDROMA INVOLVING THE GASSERIAN GANGLION

Doctor Elsberg presented a woman, thirty-nine years of age, who had suffered from pain over the left side of the face, most marked in and around the left eyeball for four months. The pain came on in paroxysms, was excessively severe, and uninfluenced by medical treatment. Upon examination, the only physical signs were corneal anæsthesia on the left, irregular areas of diminished sensation and other areas of hypersensitiveness over the area of distribution of the left trigeminus, and distinct weakness and atrophy of the left temporal and masseter muscles.

In July, 1925, a craniotomy was performed and the left Gasserian ganglion exposed. The third branch of the ganglion was covered by a small yellowish-gray tumor about 1 x 1 centimetre in size which was adherent to the sheath of the nerve and which could be removed without difficulty. After the operation, the pain was relieved to a great extent, and there was a rapid return in the power of the temporal and masseter muscles. The pathological report showed that the tumor was a true neurofibroma—a rare form of growth in this location. Most of the tumors of the Gasserian ganglion or its branches are not true tumors of the ganglion, but are sarcomas or endotheliomas which cause symptoms from pressure upon the ganglion or its branches, but the case here reported was a true trigeminal nerve growth which probably originated from the sheath of the mandibular branch of the trigeminal nerve.

Doctor Elsberg then presented a woman, aged twenty-eight years, who in February, 1924, noticed a drooping of the right eyelid which progressed rapidly, so that at the end of two weeks there was complete ptosis. It was supposed to be a case of encephalitis and in spite of a negative Wassermann was treated for lues. As she did not improve she was sent to Vienna where she saw Professor Schlesinger, who also gave her anti-specific treatment, after which she improved considerably. She then returned to New York and soon had a recurrence of her symptoms. At the same time she

began to complain of pain in the right frontal region and received antispecific treatment here without benefit and again returned to Vienna, where she was treated without benefit. The symptoms have persisted and grown steadily worse and recently the vision in the right eye has become very poor, soon afterwards followed by loss of vision in the left eye. She has frequent headaches and vomiting.

On physical examination there were no signs except those referred to the cranial nerves. There was complete drooping of the upper lid on the right side and a complete immobility of the right eyeball. The fundi were pale but normal. There was a distinct anæsthesia over the first and second branches of the right trigeminus with marked atrophy of the temporal and masseter muscles.

X-ray examination showed a slight calcified mass just behind the sella turcica.

Through a typical incision for trigeminal neuralgia the third branch of the trigeminus was exposed. In front of it lay a tumor 2 x 3 cm. in size, well encapsulated. An incision was made in the capsule and the tumor contents thoroughly enucleated. Her general recovery was very satisfactory from the operation and there was a very striking improvement in all her symptoms. Her headache ceased; there was considerable return of motor power in the temporal and masseter muscles; the vision was markedly improved; she has continued to improve up to the present. *Pathological report* was chondroma.

PITUITARY TUMOR ON THE FLOOR OF THE THIRD VENTRICLE

Doctor Elsberg presented a boy, sixteen years of age, who was seen and operated upon at the Presbyterian Hospital. The boy had been suffering from headaches for many years, and for four years had had polyuria and polydipsia and had been treated for diabetes insipidus. Two months before his operation, he began to be increasingly dull and drowsy with continual headache which became progressively worse. For three weeks his vision had been growing progressively worse. Four days before admission to the hospital, the right eye was practically blind and vision in the left eye was much reduced. When he was admitted he had a glandular abscess in the left side of the neck, which was incised and which contained typical tubercular degenerated material.

He was an underdeveloped boy, very drowsy and sleepy, and the physical examination was not satisfactory on account of poor coöperation. Vision was so much reduced that he could not count fingers at ten centimetres and he seemed to have a bitemporal hæmianopsia. There was complete paralysis of the right sixth nerve and almost complete paralysis of the left sixth, with some involvement of the third nerve on each side. There was slight papillœdema. His blood-pressure was low, 88/36, and the X-ray showed a backward tilting of the posterior clinoid processes, undoubtedly due to a tumor in this location.

January 14, 1926, a large osteoplastic flap was turned down on the right side, the frontal lobe elevated, and a tumor exposed lying above and behind the sella turcica. It was well encapsulated and an incision was made into it, and a large amount of tumor tissue removed with a curette until a cavity 2 to 3 cm. in size remained. The bone flap was returned into place, and the wound closed.

His general condition began to improve very quickly, and his vision improved very much. When last examined there was 20/40 vision in the right eye and 30/30 in the left eye. The bitemporal hæmianopsia had disappeared and the fields were now complete. The third and sixth nerve

paralyses had practically entirely disappeared. He occasionally has slight headache and still has polyuria. He has been receiving X-ray treatment.

CARCINOMA OF LARYNX, PHARYNX, TRACHEA AND ŒSOPHAGUS

DR. FRANZ J. TOREK presented a woman, forty-seven years old, who dated her symptoms back ten months previous to her operation. She then had pain in her throat and difficulty in swallowing. She was first treated for a cold without success. Then she had her tonsils removed with a slight temporary improvement. But her dysphagia recurred very soon after her tonsillectomy. In the last few days her dysphagia was very severe. Then Dr. Edward Pratt was consulted, who found a mass in the right pyriform fossa involving the right arytenoid cartilage, causing paralysis of the right vocal cord. The other side was also swollen, but its mobility was fairly normal. An X-ray picture showed the upper œsophagus also to be involved.

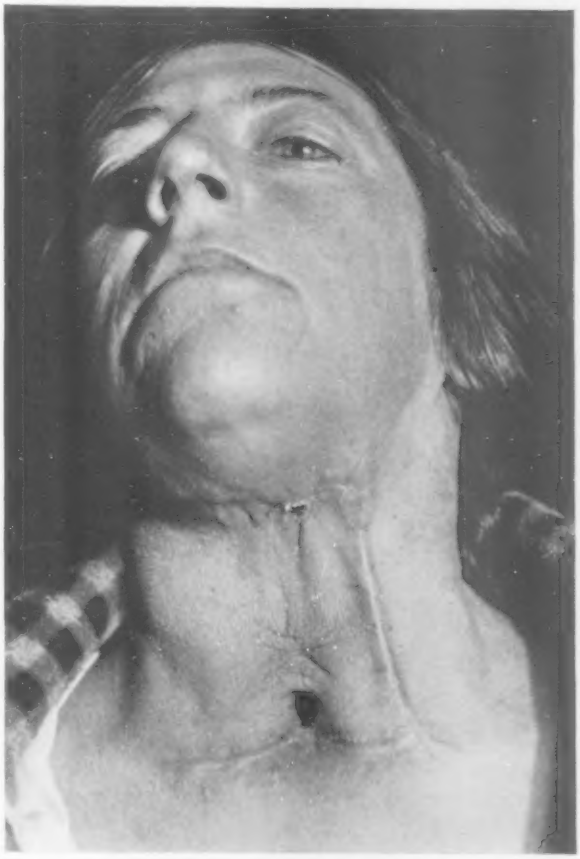

FIG. 1.—Result after resection of larynx, pharynx, trachea and œsophagus for carcinomia.

March 30, 1926, Doctor Torek performed a Witzel gastrostomy under local anæsthesia. Four days later, April 3, the resection of the larynx and oesophagus was undertaken under colonic anæsthesia, 4 ounces of ether and 2½ ounces of oil being used. A quadrilateral incision was made with its base over the right sterno-cleido-mastoid muscle and extending from the hyoid bone to the suprasternal notch. The flap, thus outlined, including the platysma, was turned over to the right, exposing the muscles of the neck. In the midline the muscles were separated bluntly exposing the larynx, thyroid gland, and trachea. The isthmus of the thyroid was divided. The constrictor muscles of the pharynx were cut. The vessels, including all the thyroid arteries, were ligated. The trachea was bluntly separated from the œsophagus at the second tracheal ring. The trachea was then divided between the second and third ring, which appeared perfectly normal, but at the posterior, soft wall of the trachea this cut went through cancer tissue. The posterior wall of the trachea was therefore excised for a distance of three additional rings. The defect thus made was sutured with fine chromic gut, diminishing the lumen of the trachea. The œsophagus was also involved

to a lower point than had been expected. It had been intended to suture the divided œsophagus to the lower margin of the skin flap with the view of later reconstructing it by forming a skin tube, but this plan had to be abandoned, for the extent of involvement necessitated a resection in its upper thoracic portion, and after the division of the œsophagus its stump lay fully 5 cm. below the sternal notch. The larynx, pharynx, and œsophagus were then separated from the vertebral column and removed. The epiglottis was allowed to remain. The pharynx was closed by a fine chromic gut suture. The right lobe of the thyroid was removed with the mass, as it appeared to be in danger of necrosis. The left lobe, which looked better, was implanted between the muscles of the left side. The trachea was sutured to the margins of the skin wound. The muscles of each side were loosely united with chromic gut. An iodoform gauze and a split rubber drain were introduced on either side of the trachea. The skin was sutured with silk except at the region of the suture of the pharynx, to allow for possible leakage. An iodoform gauze tampon was placed there. The upper wound was dressed dry, the lower wound, around the tracheal orifice, was covered with vaseline gauze. The upper tampon was removed on the fourth day. There was no leakage from the pharynx suture, but the wound suppurated till the sixteenth day, when a piece of necrotic tissue came out, probably a portion of thyroid gland. Then the wound remained dry. The drains to the stump of the œsophagus were removed between the fourth and seventh days. At first the patient used no tracheal cannula, but as the opening was rather small, owing to the excision of the posterior wall of the trachea, it became necessary on the sixth day to stretch the trachea and introduce a tube. The patient chews her food and spits it into a funnel connected with the stomach tube. She has gained twenty pounds. Her whispering speech is steadily improving.

The pathological report was: Prickle cells in nests with pearl formation. Marked diversity in size of cells; increase of chromatin in many. A type of epithelioma classed by some among the highly malignant.

JEJUNAL ULCER FOLLOWING GASTRO-ENTEROSTOMY

Constantine J. MacGuire, Jr., presented a man, thirty-six years of age, who December 23, 1923, was admitted to the First Surgical Division, Bellevue Hospital, suffering from a pyloric ulcer. Posterior gastro-enterostomy was done and his symptoms were relieved for nine months. Then pain recurred but lower down and to the left. It came on about two hours after meals. No vomiting. An X-ray examination located an ulcer in the jejunum about 2 cm. beyond the gastro-enterostomy stoma. May 25, 1925, he performed a second operation and found the duodenum almost replaced by scar tissue and completely stenosed. There was an ulcer in the jejunum as shown in the X-ray. It was firmly attached to the posterior surface of the transverse colon which formed the base of a crater which had completely passed through the jejunal wall.

The ulcer-bearing section of the jejunum was resected. The distal half of the stomach and the pylorus were removed and the stump of the duodenum closed. The excised portion of stomach contained the old gastro-enterostomy stoma. The distal limb of the jejunum was now anastomosed to the open end of the stomach stump, and the proximal limb of the jejunum, which was very short, was planted low down in the side of the distal limb of the jejunum.

It was felt that after this there would be but little acid-forming area of stomach left, but after nine months relief from symptoms not only was there recurrence of pain, but there have been several severe hemorrhages into the bowel. X-ray now shows another marginal ulcer and although the

patient is at present under a Sippy diet and temporarily a little improved, his condition is generally miserable. He is shown as an unsatisfactory result following first conservative operative treatment. He apparently has the capacity to form ulcers independent of the acid-forming section of the stomach.

Doctor MacGuire presented also a man who, when thirty-four years of age, was admitted to the First Surgical Division Bellevue Hospital, April 3, 1922, with a history of four months' gastric distress. He suffered from pain coming on about one-half to one hour after meals. Made worse by food and relieved by soda, vomiting, belching or pressure.

X-ray showed pyloric obstruction. Gastric contents showed free HCl 25—total acidity 80. He was operated upon April 20, 1922, a tremendously indurated duodenal ulcer with welled-off perforation adherent to gall-bladder was excised with cautery and sutured. A posterior gastro-enterostomy was done without clamps as they have abandoned clamps for some years in order to obtain more certain hæmostasis. In spite of this there was a profuse post-operative melæna and a transfusion had to be given. The patient was entirely relieved of his pre-operative distress for about nine months, but then pain recurred, but more severe and two hours after meals.

The patient was re-operated upon October 31, 1924. The duodenum was found stenosed with apparently no acute process present. There was an ulcer in the jejunum just beyond the gastro-enterostomy stoma. This ulcer was of the perforating type with the base of its crater formed by the posterior surface of the transverse mesocolon just as in the previous case. The gastro-enterostomy was detached, the jejunal ulcer excised, the distal half of the stomach and pylorus removed and a Billroth II performed. This has resulted in a complete cure. For two and a half years the patient has been in splendid health, weighing over 200 pounds.

GASTRIC ULCER

Doctor MacGuire then presented a woman, who was admitted to the First Surgical Division of Bellevue Hospital, December 9, 1924. Her age at that time was forty-five years. She gave a one-month history of substernal pain, coming on one hour after meals, and usually followed by vomiting and relief. On the date of admission there was a profuse hæmatemesis, so severe that the patient looked exsanguinated. After six weeks in bed and two small transfusions and a very careful restriction of diet her condition improved sufficiently to permit operation, which was done January 16, 1925. At operation an indurated area on the anterior surface of the pylorus around which there were peritoneal adhesions with stippling was judged to be the site of the ulcer. A pylorectomy was performed but the excised portion revealed no ulcer. The lumen of the proximal gastric stump was palpated but no ulcer was felt. Finally the stomach was rolled inside out upon itself, and this revealed an ulcer on the lesser curvature which was the site of the hemorrhage. This portion of the lesser curvature was excised down to include the upper half of the stomach stump and the gap sutured. The lower half of the stomach stump was then used for anastomosis with the jejunum which had been brought up through the posterior mesocolon. The woman had an uneventful convalescence and has remained free from symptoms referable to her gastro-intestinal tract with the exception of occasional eructation of gas. This very radical operation was done on this patient to prevent the possibility of further hemorrhage.

Doctor MacGuire presented a fourth patient, a man who was admitted to the First Surgical Division of Bellevue Hospital, November 6, 1924. His

age at that time was thirty-two. He gave a history of operation for acute perforated ulcer of the duodenum three years previously. He was symptom-free for a year and then developed pain coming on two hours after meals. X-ray revealed duodenal ulcer. Operation November 7, 1924, revealed not only evidence of old healed duodenal ulcer, but of a large crater on the lesser curvature of the stomach, which was the base of a penetrating gastric ulcer. The only curative procedure here seemed to be a resection of the distal half of the stomach with the first portion of the duodenum. This was then done and the jejunum then brought up anterior to the colon and anastomosed to the open end of the stomach. The operation was complicated by very extensive adhesions throughout the right upper quadrant and right lumbar gutter, probably the result of his perforation three years previously. The patient made a very smooth recovery and has been free from untoward digestive symptoms to date. He fails to gain weight but this is probably due to the fact that he smokes between thirty and forty cigarettes a day.

THE TREATMENT OF CUTANEOUS BURNS

Dr. Frederic W. Bancroft read a paper with the above title, for which see page 1, Annals of Surgery, vol. lxxxiv.

Dr. Allen O. Whipple said that this was a very interesting contribution to a subject usually considered uninteresting in many hospitals. To the speaker, the demonstration was most interesting of the process said to assist the spreading of air follicles in the sebaceous glands beneath the crust. Looking through the records at the P. and S., Doctor Whipple had been disappointed not to get visible evidence of this, and he felt sure these photomicrographs were rare as applied to burns. He wished to ask Doctor Bancroft if he had noticed evidence of poisoning in the use of tannic acid solution in young children in the first three weeks of life. He happened to see a toxic case of a newborn infant badly burned by means of an electric bulb. The lower extremities were badly injured and the question arose if it was safe to apply tannic acid in the case of a child so young. As recovery seemed to be progressive, it was felt unwise to apply it in that case.

Dr. Seward Erdman said that his chief interest deals with the pathology of burns, which Doctor Bancroft has brought out so well. The old surgery taught that ulcers of the duodenum occurred as an effect of cutaneous burns, and the speaker was curious to know the present status of opinion in that regard. He had never had such a case called to his attention and had never met a man who knew of a case of deep ulceration of the duodenum as a result of cutaneous burns, although ulcers of the duodenum are so common in surgery, and he wondered if this is a myth or if it really does occur and why. A child five years of age was brought to the New York Hospital badly burned and died in three days. The child vomited on the day of death and the nurse said the child vomited blood. No autopsy was obtained. Was this simply an inflammation of the mucosa causing slight hemorrhage, or was it an indication of deep duodenal ulceration?

Dr. Seth M. Milliken said that he was deeply grateful to the reader of the paper for leaving out the mention of Carron oil, which is the worst method of treating burns. He agreed with the speaker that burned children

have to be carefully watched and the method of treatment changed as the condition changes. The speaker does not approve of débridement, but he believes longitudinal incisions are better than radiating incisions. He had never used tannic acid because he was afraid of the tanning effect; if cellulitis is dammed in it may have an augmentative effect. In granulations he treats them by covering the granulating surface with adhesive plaster. In using the adhesive plaster in superficial burns, he puts it on as soon as possible after the burn occurs; it keeps the area moist. He approved of the use of water as a wet dressing during the painful stage; after this the adhesive plaster can be put on as it does not damage the tissue during the advance of healing.

Doctor Bancroft, in closing the discussion, said he had never seen any toxic effects from the correct use of tannic acid and he had treated children up to two years of age. He had seen late effects which he was not sure were due to the tannic acid or to the burn, such as rise of temperature and abdominal distention. He had not been able to get any autopsies. The Coroner's physician will not allow autopsies for burns so he had not seen any duodenal ulcers but punctate hemorrhage of the small intestine had been observed by other writers, and it seemed to the speaker that this is what occurred in his distention cases, and it apparently affects the adrenals. He agreed with Doctor Milliken about débridement; it was used between the time the old treatment was abandoned and the tannic acid treatments were begun and lives have been saved with it, but the after-treatment was very difficult in extensive burns. If the cases are not treated with tannic acid, débridement is advisable in certain cases. He had always hoped for an opportunity to do primary débridement and grafting in small, deep burns. He had often made longitudinal incisions to relieve tension. As to adhesive plaster, if early grafting is done it will not be needed. It is easy to do a pinch graft which saves time and hastens epithelization. Both saline and glucose have been used intravenously. Tannic acid gives relief of pain and so picric acid is not needed.

BRIEF COMMUNICATIONS

DIAGNOSTIC INTRASPINAL INJECTIONS OF LIPIODOL

In the January, 1926, number of the Annals of Surgery (1926, vol. lxxxiii, p. 32) Drs. Wm. Sharpe and C. A. Peterson published an article on "The Danger in the Use of Lipiodol in the Diagnosis of Obstructive Lesions of the Spinal Canal."

Judging from their statement of three cases—the only cases in which the method was employed by the authors—we think that mistaken deductions might be drawn with regard to the harmfulness of the method.

From our personal experience, gathered during more than four years, and referring to some hundred subarachnoidal injections, confirmed by different authors whose names are cited by Sharpe and Peterson, we can on the contrary formally state the absolute harmlessness of the method—if the indications given by us are followed.

Sharpe and Peterson are astonished because lipiodol is not absorbed more than one year after injection. It is a fact to which we have drawn attention with Y. Forestier many years ago—and that is a special property of iodized oil. We have never observed symptoms the existence of which could be attributed to lipiodol not being absorbed: neither pains nor incontinence as could have been inferred by the reports of Sharpe and Peterson.

From another point of view, contrary to the statement of the authors, *never is lipiodol encysted, when there is no arachnitis,* and two years after injection, it is as mobile as on the first day.

If there is arachnitis, lipiodol is blocked and encysted. The authors may think—but it is only a personal point of view—that blocked lipiodol has a harmful action. But their observation does not prove that harmfulness; the case in question consists in an illness, increasing spontaneously during two years, and it was only many months after injection of lipiodol, and after a laminectomy that the illness showed aggravation.

There is no more reason to suggest an aggravation caused by lipiodol, than spontaneous or post-operative aggravation.

We would like to draw attention to the fact that if the authors had followed the indications given by the lipiodol, they would have operated immediately. A second operation would not have been necessary, and encystment would have been avoided.

We have already, since a long time, suggested the method proposed by the authors: The Trendelenburg shoulders-and-head-down position. Lipiodol after examination falls in the lower lumbar theca, and does not remain on the level of the lesion. We do not employ any other method.

Neither do we agree with Sharpe and Peterson about the harmlessness of injection of air, no more than of exploratory laminectomy; their own observation is a proof.

We must also draw the attention of the readers to the following: The

principal case, the Case I of Sharpe and Peterson, was also published by A. S. Maclaire (*Am. J. of Med. Sc.*, 1925, vol. clxx, p. 874). No mention is made of this, which gives the impression that there were two separate cases.

We will also call to mind that, contrary to the authors, we do not use the product in ampoule form. Lipiodol undergoes a change when kept in glass: iodine can be liberated, and cause pains during two or three days, as in the Cases II and III of Sharpe and Peterson. It is for that reason that we use only lipiodol kept in aluminium.

To conclude, we can guarantee the harmlessness of the method, if our indications are followed. We can assert that, in numerous cases this method has enabled us to localize lesions before the appearance of clinical signs, in spite of the statement of Sharpe and Peterson.

However, we are ready to use another product opaque or transparent for X-rays, if any superior to lipiodol is proposed.

We should also like to insist upon the necessity of *interpreting* the films. The technic is easy, without any danger, but the difficulty is to distinguish between pathological spinal block and a "false block."

At last, we never said that a spinal block of lipiodol was necessarily an indication for operation.

Prof. J. A. Sicard, M.D.,
J. Hagueneau, M.D.,
Paris, France.

A HEAD REST FOR CEREBELLAR EXPLORATION

The head rest illustrated (Figs. 1, 2 and 3) has been in use in the Cincinnati General Hospital for the past four years. It is intended par-

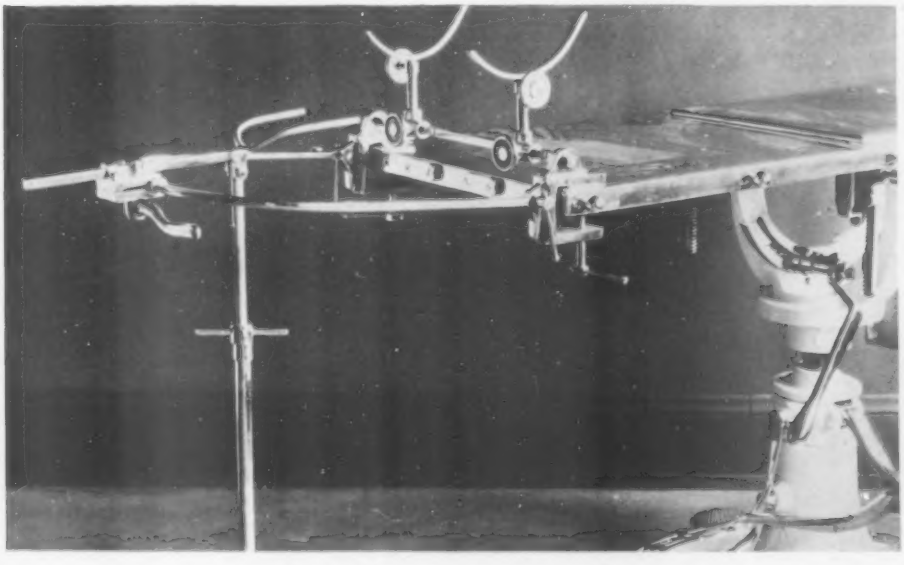

Fig. 1.—Apparatus attached to table.

ticularly for occipital craniotomies, but is useful also in spinal or posterior thoracic surgery or wherever the anæsthetic must be given with the patient

lying face down. It is similar in principle to the one in use in the clinic of Dr. Harvey Cushing.

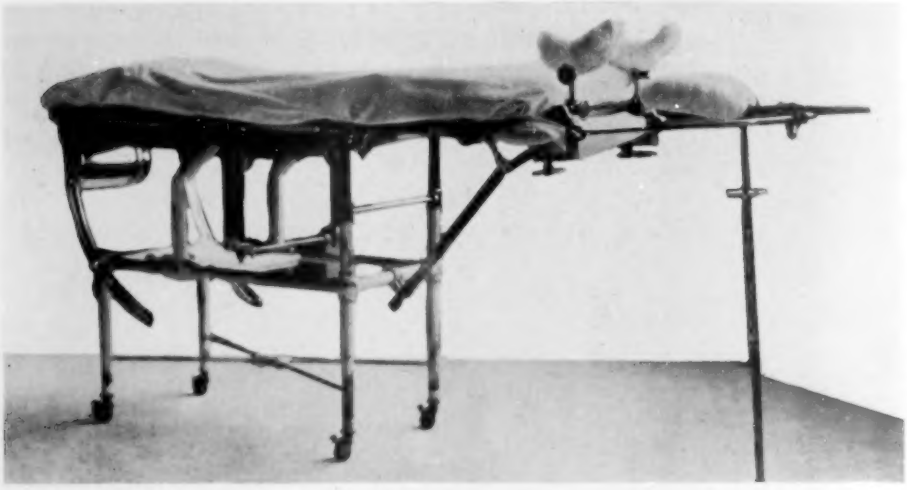

FIG. 2.—Apparatus padded, ready for patient.

The features of the apparatus which have been found particularly useful are the following:

1. It is easily attached to any table.

FIG. 3.—Patient in position. The arms are bandaged to the loop.

2. The head is supported firmly and comfortably so that it is not unstable during operative manipulations.

3. The distance between the shoulder supports, the height of the shoulder

supports, the height of the head support and the distance of the head support from the body are all adjustable so that the apparatus can be used on patients of any size.

4. The loop to which the head support is fastened serves as an excellent rest for the patient's arms and also holds the drapery away from the anæsthetist.

5. When the operation is finished, the loop and attached head support may be dropped entirely out of the way so that the head dressings may be applied without hindrance.

The apparatus is made by the Max Wocher and Son Co., of Cincinnati, Ohio.

JOHN A. CALDWELL, M.D.,
Cincinnati, Ohio.

THE WHITMAN RECONSTRUCTION OPERATION

The reconstruction operation of Dr. Royal Whitman has proven its usefulness in cases presenting non-union following a fracture of the neck of the femur and in selected cases of osteo-arthritis of the hip. The operation is of short duration, subjects the patient to little trauma. The following case

FIG. 1.—Röntgenogram, taken April 5, 1924, showing old ununited fracture of the neck of the left femur with absorption of the neck.

two years after operation is presented to show the range of painless motion attained by this type of reconstruction.

FIG. 2.—Röntgenogram, taken immediately after operation, showing the transplanted greater trochanter with the newly formed neck in the acetabulum.

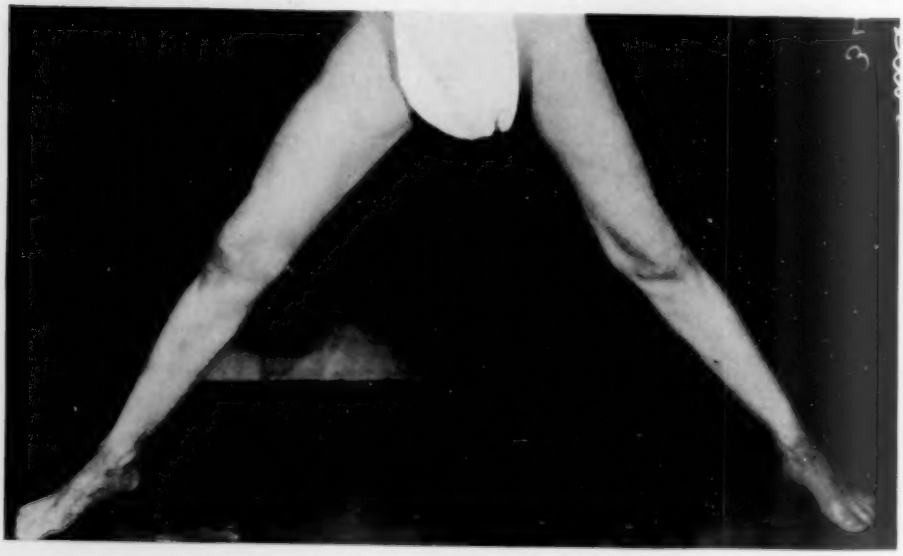

FIG. 3.—Photograph showing the degree of abduction of the left hip.

FIG. 4.—Photograph showing the position of the hip when patient is ascending steps.

FIG. 5.—Photograph showing the degree of flexion obtainable in the left hip. Note also the U-shaped skin incision.

This patient, age forty-seven, was seen in April, 1924, and gave a history of having fallen from a wagon a year previously, injuring the left hip. He had been treated by rest in bed and a diagnosis of "laceration of the left hip" had been made. One year after the injury he was walking with crutches, complaining of constant and extreme pain in the left hip on movement. An examination showed that the left leg and foot were rotated outward, that the greater trochanter was elevated above Nelaton's line, and that there was two inches of shortening on the affected side. A röntgenogram showed an old

FIG. 6.—Röntgenogram, taken June 3, 1926, about two years after the Whitman reconstruction operation was performed.

fracture of the neck of the femur with the head in the acetabulum and almost complete absorption of the neck. (Fig. 1.) On April 14, 1924, I operated upon this patient at the Hospital for the Ruptured and Crippled, transplanting the greater trochanter with its attachments downward onto the shaft and after removing the partly absorbed head, the newly formed neck was placed in the acetabulum as shown by the röntgenogram. (Fig. 2.) A long plaster-of-Paris spica was applied with the limb in moderate abduction, which was worn for four weeks. This was replaced by a short spica and the patient allowed to walk with the aid of crutches. About two months after operation all plaster was entirely removed, and active and passive motion with massage begun.

The present range of flexion and abduction are shown in the accompanying photographs (Figs. 3, 4 and 5) and a recent röntgenogram shows the condition of the joint

(Fig. 6) which is stable and painless. The patient states that for the last few months he has been engaged as a patrolman of a beach and that he has no discomfort whatever in walking long distances.

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THE END RESULTS OF A URETERAL ANASTOMOSIS

The average surgeon is rarely called upon to restore the continuity of a severed ureter. Still more rarely has he the opportunity of recording the result by pyelography after the lapse of a number of years. In the case here reported the anastomosis was performed almost seven years ago, and I feel that the result after that length of time is of sufficient interest to justify reporting it.

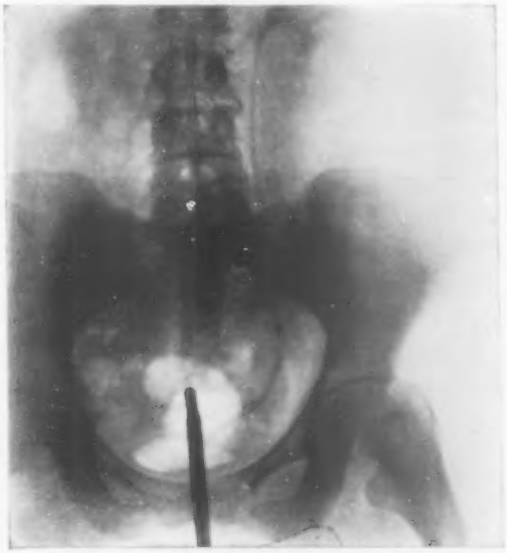

FIG. 1.—Pyelogram made almost seven years after operation to restore the continuity of severed ureter. It will be seen that there is no dilatation of the ureter or pelvis of the kidney.

In July, 1921, the author reported in the ANNALS OF SURGERY (July, 1921, p. 92) a case of uretero-ureteral anastomosis, performed two years previously. The history of the case was then given but a brief synopsis may not be out of place here. In July, 1919, the writer operated upon a patient for multiple fibroids of the uterus. The tumor mass was firmly impacted in the pelvis and considerable difficulty was experienced in dislodging it. The broad ligaments were opened up and a fibroid the size of a large grape fruit encountered low down in the pelvis on the right side. When this mass was freed from its surroundings there was considerable bleeding from dilated veins in the broad ligament. In placing a hæmostat on these bleeding vessels, the right ureter was caught in the tip of the forceps, with the result, that when the mass was lifted out of the pelvis, the ureter was torn almost completely across, the ends being held together by a mere shred of tissue. The ureter in this case lay across the anterior convexity of the tumor near the median line, having been carried by the intraligamentous fibroid forward and inward in its growth. The bladder was crowded over into the left half of the pelvis. After completing the hysterectomy the continuity of the ureter was restored by a modification of Van Hook's method, the details of which have been already reported.

A year and three months later the patient returned for examination. The

ureteral orifice on the affected side was seen to be functionating normally. Catheters were placed in both ureters and clear urine dripped normally from both sides. An intravenous injection of phthalein appeared simultaneously in the urine from both kidneys in eight minutes. The catheterized specimens obtained from both kidneys were free from pus or bacteria.

She was not seen again until April, 1926, almost seven years after the anastomosis had been made. She stated that during that time she has been in perfect health. Cystoscopic examination was carried out on April 20, 1926. The bladder and ureteral orifices were found to be normal. Catheters were then placed in both ureters. The left passed readily to the pelvis but the right was arrested at a point about 12 centimetres from the ureteral orifice. Specimens of urine from both kidneys were collected, which, when examined were found to be normal. The catheters were then withdrawn and an intravenous injection of indigo-carmine given. The dye was seen to spurt normally from both ureteral orifices in about five minutes. The ureteral catheter was then reinserted into the right ureter and 12 c.c. of 20 per cent. sodium bromide solution injected and a röntgenogram made. The röntgenogram showed the ureter and pelvis of the kidney to be normal and without the slightest trace of dilatation above the point of anastomosis. The end result of the operation to restore the continuity of the severed ureter can in this case, I believe, be considered perfect.

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PARTIAL EXCISION OF THE SCAPULA FOR ENCHONDROMA

Excision of the scapula, whether for benign or malignant growths, has been rather a rare procedure in the past twenty years. Numerous cases have been reported and described, but not much stress has been laid on the mechanics of the operation nor the judgment of the extent of the excision. The prime object has been to preserve the greatest function of the arm with as little danger of recurrence of the tumor as possible. To such an end, conservation of the glenoid cavity with the joint capsule and as much of the scapula as could be safely preserved, was to be sought, providing, of course, that the entire scapula might not be consumed by a malignant growth. A firm foundation for the head of the humerus with reinforcement by muscular and bony tissue is gained so that eventually those muscles still remaining can adapt themselves to the weakened condition of the shoulder to produce a useful arm.

Cases in which it is possible to perform the operation of excision of the scapula may be readily divided into two groups from a surgical standpoint: (1) Cases in which nothing short of complete removal or even interscapulo-thoracic amputation will suffice, and (2) cases in which only partial excision is necessary. The patients in Group 2 will be limited to those with benign,

FIG. 1.—Appearance of enchondroma involving entire posterior surface of the left scapula. The tumor was about 15 cm. in diameter.

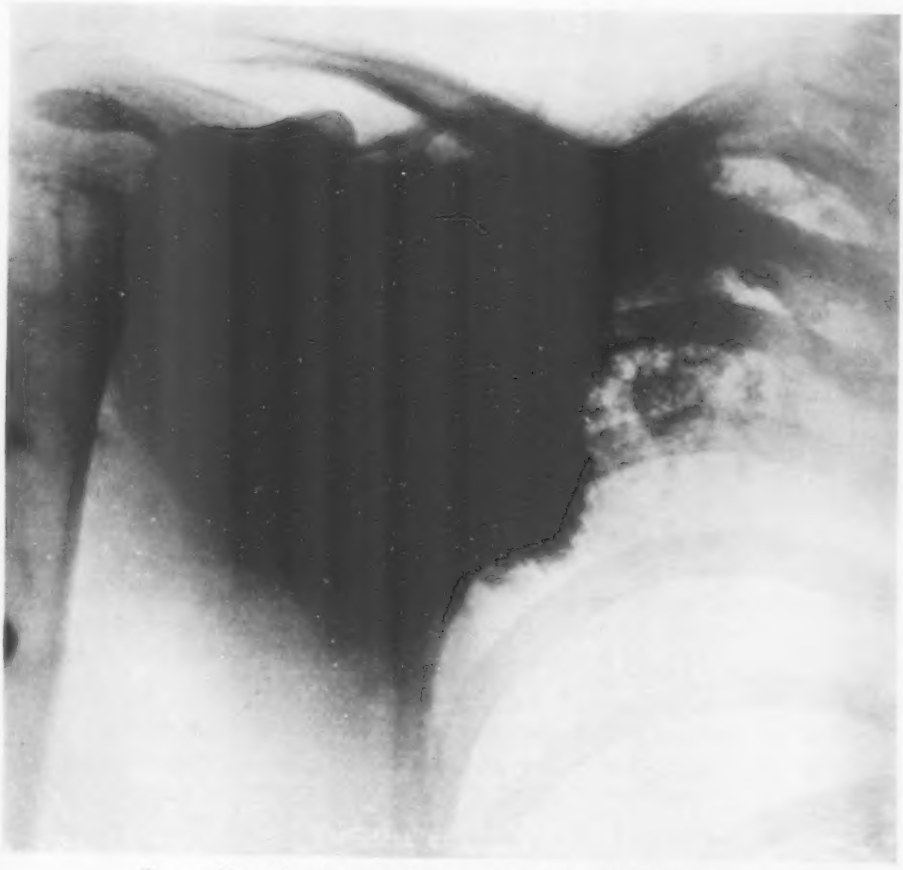

FIG. 2.—X-ray showing complete involvement of the wing of the scapula.

or comparatively benign growths, very early malignant growths in which there is no evidence of extension, and diseases involving only a portion of the bone. Naturally, Group 2 comprises a rather small number of cases. The more conservative procedure should be the operation of choice in cases of enchondroma in which the growth is localized and benign. When the growth invades and fills the blood-vessels and cases in which discontinuous metastasis occurs, such a conservative operation is, of course, out of the question.

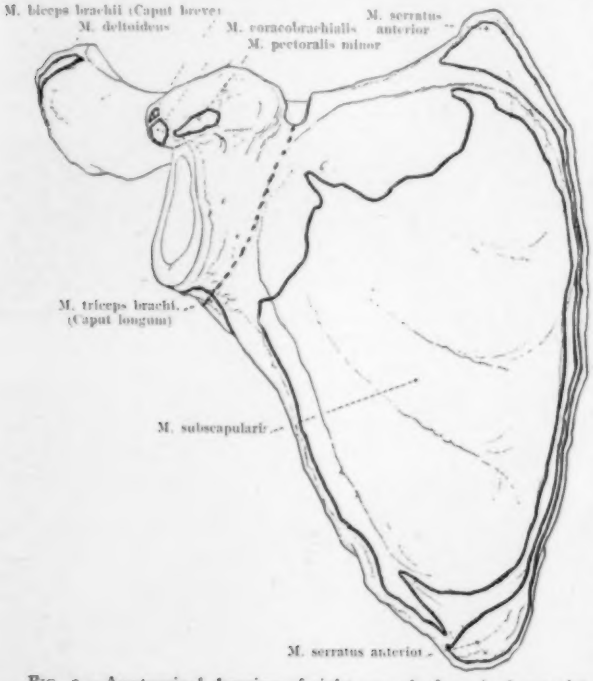

FIG. 3.—Anatomical drawing of right scapula from in front with its muscular attachments. Operation was performed on the left scapula, but the dotted line represents, relatively, the line of division of the bone.

A brief study of the scapula from an anatomical viewpoint will readily show that an operation which could be performed leaving the glenoid, coracoid and acromion processes intact would not materially weaken the shoulder or embarrass the function of the arm. Furthermore, the bases of these processes arise close together at the narrowest point of the bone, and so this part of the operation is comparatively simple to perform. Thus, not only is a solid foundation preserved for articulation of the head of the humerus, but the attachment of the coraco-brachialis, pectoralis minor, short head of the biceps, long head of the triceps, and a portion of the deltoid and trapezius muscles are maintained intact.

Buchanan,[1] in a review of the literature on excision of the scapula in 1900, cited ninety-four cases of partial excision of growth in this region. These excisions varied in extensiveness from removal of all of the bone except the acromion or coracoid processes, alone or together, or the glenoid alone, to simple removal of the lower angle of the bone. Nowhere is mention made of preservation of all three of these processes when an extensive resection was necessary as in the case reported here.

CASE 25974.—Miss O. G., aged thirty-one years, came to the Clinic, July 28, 1923.

[1] Buchanan, J. J.: Total excision of the scapula alone, and with the arm (interscapulothoracic amputation): partial excision of the scapula for tumor. Philadelphia M. J., 1900, vol. vi, pp. 73–82.

because of a painful growth in the left shoulder which had been gradually increasing in size for the past two and a half years.

Examination revealed a well developed young woman with a tumor about 15 cm. in diameter involving the entire posterior surface of the left scapula (Fig. 1). There was no attachment to the skin; the surface of the growth was smooth but very hard. No lymphatic enlargement was noted. X-ray examination showed envolvement of the entire wing of the scapula (Fig. 2). Diagnosis of enchondroma was made and confirmed by biopsy. The patient was referred to the hospital for operation, July 3, 1923.

A U-shaped incision over the shoulder with the skin flaps freely dissected back gave an excellent exposure. It was now observed that although the tumor completely covered the posterior and upper surfaces of the scapula, it might be possible to remove the growth entirely and still preserve the acromion, coracoid and glenoid processes. If this

FIG. 4.—Appearance of patient three years after operation. There was no recurrence of growth at that time.

could be done, I could preserve excellent function in the arm and shoulder by saving the muscular attachment to these processes. The trapezius, supraspinatus, and teres major and minor were cut through, and the posterior scapular artery ligated. Through a continuation of the wing of my original U-shaped incision along the anterior border of the axilla the subscapular artery and vein were ligated. This procedure allows complete control against hemorrhage. The subscapular muscle was severed at its attachment to the humerus. I then proceeded to cut through the spine of the scapula itself at its narrowest part; that is, from the incisura scapulæ to a point just below the glenoid fossa (Fig. 3). This allowed me to lift out the tumor with the attached wing of the scapula (Fig. 4) and all that remained was to sever the attachment of the serratus magnus. The remaining portion of the scapula, with its preserved bony processes, was held in position by stitching it to the muscles of the chest wall. A rubber drainage tube was left in place for twenty-four hours at the lower angle of the wound.

The patient made an uneventful recovery except for some sloughing of the skin on the posterior chest wall, which was later covered by a simple sliding graft. The slough was probably due to the patient's being allowed to lie on her back for several hours following the operation.

When the patient left the hospital she was given full instruction for exercise and

development of the muscles of the shoulder. Within three months from the time of her operation she had returned to her occupation as a waitress with full use of the arm and excellent muscular power in the shoulder. Figure 4 shows the final result three years after operation; there was no recurrence of the growth at that time.

JAMES A. JACKSON, M.D.,
Madison, Wis.

TUBERCULOUS OSTEOMYELITIS

Osteomyelitis of the long bones of tuberculous etiology, not associated with joint tuberculosis, has been pretty well established as a clinical fact and

FIG. 1.—Pre-operative film in lateral view. Joint surfaces entirely clear. Slight anterior subperiosteal proliferation corresponding to capsular attachment, but otherwise no particular changes.

FIG. 2.—Post-operative film in lateral view, indicating the operation defect.

may be widely recognized at the present time. It still may be considered, however, a rather uncommon type of bone tuberculosis, especially in adults, for which reason submission of following case report seems justifiable:

A. R. 60,367, a real estate salesman, single, of thirty-five years, presented himself for examination, May 10, 1925, with complaint of running sore of left leg. Family history: Negative for tuberculosis or lues. Past history: Typhoid at 18; "rheumatism" left ankle at 27; Neisser infection at 20; lues denied by name and symptoms. General health excellent. Past illness: Three years previous contusion lower left leg. No disability or symptoms followed. Two years ago he began to have attacks of pain, swelling and

occasional redness in lower half of this leg. These did not cause disability, but continued for about a year, when a more severe attack occurred. At this time the leg was operated on by a local surgeon. The wound was closed around a gauze drain and continued to discharge for several weeks. A brief report from this surgeon is as follows: "There was an acute osteomyelitis of the lower end of the left tibia with a Brodie's abscess. The abscess cavity was five centimetres in diameter. A culture made of the pus proved negative. The leg had been healed only a few months when swelling and inflammation recurred and a simple drainage incision was made by another surgeon. Discharge persisted in small amount, ever since, with occasional exacerbation of subjective symptoms.

The general physical examination resulted in entirely negative findings. He was well nourished and developed, and in apparently excellent general condition. On the left

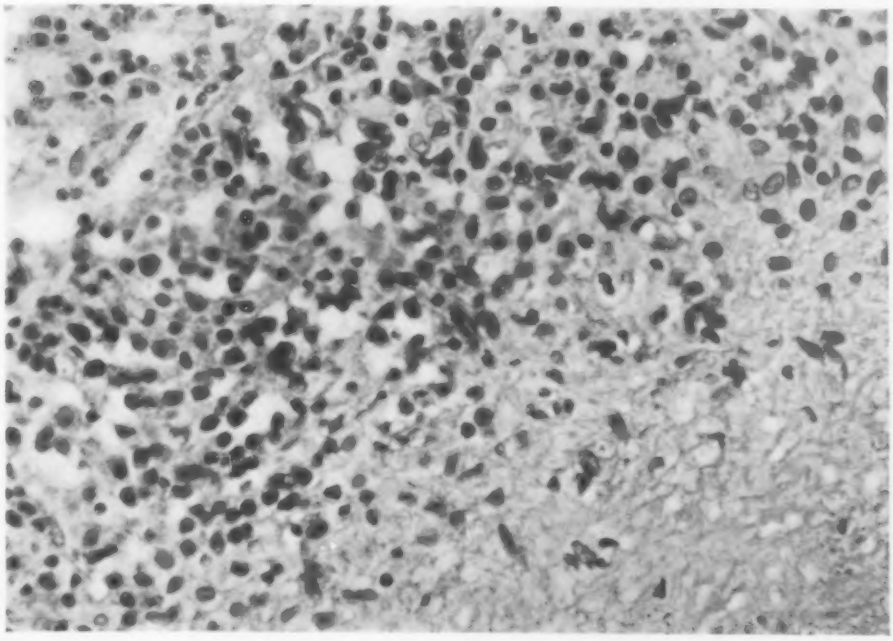

FIG. 3.—High power from area of infiltration. While no giant cells were seen, the pathologist considered the picture essentially that of tuberculosis.

leg, two and one-half inches above the internal malleolous, over the subcutaneous surface of the tibia, was a small drainage sinus, at the end of an old operative scar. There was slight infiltration around sinus, but no evidence of active inflammation. The ankle-joint was free from limitation or pain on manipulation, and there was no synovial tenderness. X-ray examination showed irregular areas of increased radiability through the metaphysis and lower end of the diaphysis, but practically no surrounding sclerotic bone shadows. These appearances were not unlike those of enchondroma, but the previous operator's report, combined with the subsequent course, seemed to establish the presumption of inflammation of bone. Routine urinalysis and Blood Wassermann tests were negative.

A clinical diagnosis of chronic infective osteomyelitis in a persisting bone cavity was made and bone operation for purpose of saucerization was advised and accepted.

Operation under tourniquet was performed on May 27, 1925, with the following notes dictated at that time: "A rather large but irregular shaped cavity was opened into occupying most of the metaphyseal portion of the tibia. It was filled with low grade granulation tissue, but contained practically no pus. It was cultured for several media, and then thoroughly cleaned out. The mesial and posterior walls were depended upon for stability and the anterior and lateral portions of the cortex were completely removed

in the saucerization process. After normal appearing bone could everywhere be seen, a little further resection to smooth out the posterior surface resulted in an opening into another bony defect, or chamber behind the fibula with an unbroken lining membrane. The latter was freed from the walls with a blunt dissector, the bony opening enlarged and a complete sac, still intact, lifted out. Necessary additional remodelling was done, but no further pockets encountered. The sac, when opened, contained cheesy material only. Cavity was packed open with gauze and Dakin's tubes for Carrel treatment."

As the operative wound culture was positive for a Gram-negative bacillus, bacterial counts of the wound were not begun until the tenth day, but at that time, and on daily subsequent smears, no microörganisms were ever found. By the eighteenth day, all bone surfaces were buried under healthy granulations, and a surface revision with

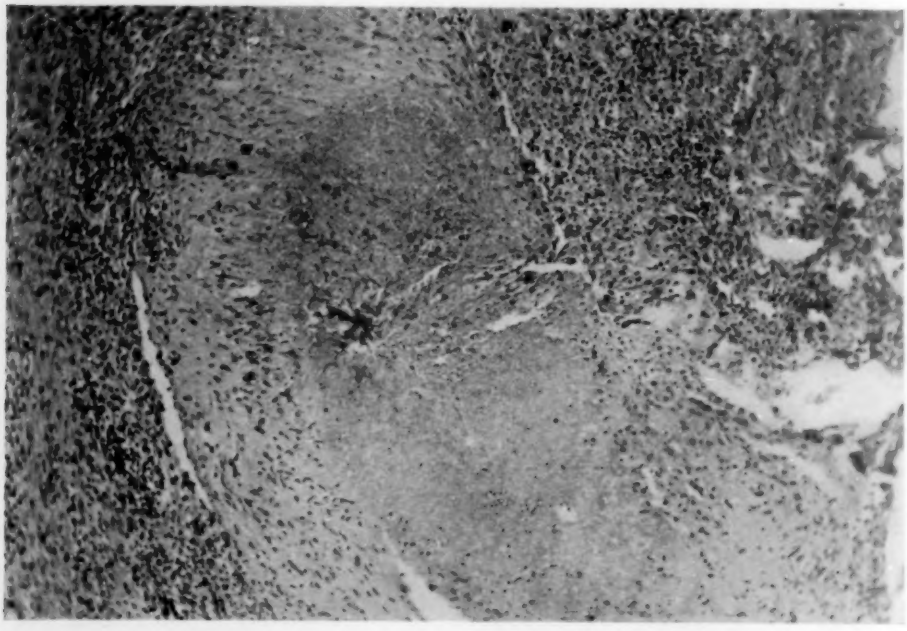

FIG. 4.—Low power microphotograph of wall of sac or membrane, showing an area of necrosis, amounting almost to caseation, surrounded by round and wandering cell infiltration.

secondary suture was performed, the wound being tightly closed in two layers, which healed by first intention. The temperature, after primary operation, went to 100 for nearly a week, when it fell to normal and remained so until discharge on the twenty-eighth day after admission, at which time he was walking on the affected leg.

Pathological examination was as follows:

"*Gross Pathology.*—One specimen consists of bits of three kinds of tissue. Small pieces of bone show a thickened periosteum and some grayish masses of granulation tissue in the medullary cavity. There is a small, soft, gray mass of tissue, a sac-like structure 1.5 cm. long and about 1 cm. in diameter, having walls which are thickened by reddish and grayish granulation tissue. Several gray nodules are visible. Included with the latter specimen, is a bit of cheesy material.

Another specimen consists of several bits of glistening, finely lobulated, red and reddish-gray tissue, mixed with bits of bone. Several tiny, yellow, caseous masses are noted. A brownish-black substance adheres to the tissues in places.

Microscopic.—Sections show larger and smaller areas of pinkish-blue, homogeneous, necrotic material surrounded by walls of epithelioid cells. Throughout the remainder of the tissue there are nests of round and wandering cells. No giant cells are seen.

Diagnosis.—Bone Tuberculosis."

Patient was continued under observation and was free from trouble for the next two months, when a small collection formed in the incision, was incised superficially and did not completely dry up for three or four weeks. The same condition recurred with slight pain and swelling on October 30, 1925. At this time he was urged to give the limb complete rest in plaster for two weeks followed by use of calipre brace to remove any possible strain or irritation from weight bearing. He declined this advice and dropped from observation from that time. The only symptoms then were the slight discharge and a sensation of weakness on walking, *i.e.*, about the same condition as on admission. No symptoms of joint involvement had appeared at any time. Action of the extensor tendons was normal. It should have been mentioned that heliotherapy was carried out but somewhat spasmodically, during these months. X-ray examination, September 9, 1925, showed no further rarefaction, but no obvious filling in of the defect.

In response to a recall letter in May, 1926, patient reappeared with story that for two months he was free from discharge or symptoms, when pain and swelling recurred. He consulted another surgeon who lanced, obtaining a small amount of pus, applied case satisfactory with early cessation of drainage. Patient then went to Florida and obtained satisfactory heliotherapy during the winter. Has been active since then with no recurrence of symptoms. Examination showed no objective signs of his disorder beyond the superficial scars. X-ray films show considerable diminution of bony defect.

CHARLES W. PEABODY, M.D., *Detroit, Mich.*

EXCISION OF INTERNAL SEMILUNAR CARTILAGE

The following method has been found effective in the treatment of the complications associated with tear of a knee-joint cartilage, and luxation of its attachments—remembering that the latter, particularly detached folds of synovial packing, may induce symptoms which, apart from absolute locking, may counterfeit those of the derangement following fracture of a meniscus. Attention is invited to the frequency of a localized synovitis at the apex of the internal patellar triangle, often produced by direct injury, with pain and tenderness accentuated at a site on the tibia suggestive of inflammation of the plica of synovial membrane situated between the head of this bone and the internal semilunar cartilage, and extending inward for attachment with latter to the internal lateral ligament. Whatever obfuscation may exist as to the exact causation, much less the exact lesion, there is small margin left for error in regard to the treatment of localized traumatism in this area—as in case of recurrence after thorough primary rest on a splint for two to four weeks there is no alternative but to remove cartilage and involved synovial excrescences.

(1) Open ether is administered—whole field well painted with tincture of iodine—with limb fully extended and slightly everted, the line of articulation is marked with point of knife on skin; with this as guide a four-inch vertical incision is made one finger-breadth internal to patella down to the capsule.

(2) A tourniquet is not employed as *every wounded vessel must be seen.* Each spirting vessel is now seized, and tied with fine catgut. When this has been properly executed, the capsule is divided in similar line and bleeding points similarly dealt with.

(3) A special assistant, deputed for purpose, is now told to flex the leg on thigh—maintaining limb in acute flexion by firmly planting the sole of foot

on operating table—this manœuvre exposes the interior, provides for liberal inspection of joint, and gives ample room for whatever "excisions" may be found necessary.

(4) The cartilage is seized in a pressure forceps, and removed with a narrow blade scalpel—a careful search is made for loose folds and tabs of synovial membrane, and these in turn are clipped away always, if feasible, ligating any bleeding point following such excision.

(5) Every effort should be made by ligation or temporary packing to stop all oozing of blood before closing the external wound—hæmarthrosis following this operation has been the cause of many untoward things.

(6) The limb is then extended, and through-and-through interrupted double silkworm gut sutures introduced through wound, care being taken to include the capsule on each side—while this is being executed a small roll of gauze is left in the joint—the ends of all the sutures are (temporarily) caught in pressure forceps—the gauze pack is then removed—a final thorough inspection made—if the joint is dry, the wound is united—but if there is any evidence of oozing of blood continuing a closed large, curved on flat, scissors is passed up behind patella to act as guide for two lateral one and a half inch incisions, just above and to each side of this bone—through each opening two waiting silkworm gut sutures are similarly introduced, and then through each a medium size wisp of silkworm gut is inserted (and skin fixed) in the synovial pouch. The main wound is now closed.

(7) The limb is placed in full extension on a long back splint with footpiece at right angle, and fixed in position by bandages, above and below, well clear of wound region. The dressing is next applied, and fixed *in situ* by special bandage, and not disturbed for one week. In case "supra-patellar drainage" has been employed the dressing of both small wounds is changed on the third morning—wisps removed, and if articular bleeding has ceased, both are closed by their waiting sutures. *In case of there being any likelihood of post-operative articular bleeding supervening,* a fine wisp of silkworm gut (ten strands doubled) should be introduced into joint through the upper angle of the incision and a waiting silkworm gut suture inserted for closure of wound after removal of the wisp drain.

(8) On the fourteenth day if the wound (or wounds) have healed, the splint is removed, the limb is retained for another week elevated on an inclined pillow between sandbags and during this period the patient, in presence of nurse, performs active movement of joint three times a day—provided same does not cause pain or subsequent swelling—if so, the active movement is suspended until it can be so executed. The patient's own muscles and own sense of pain are the only safe guides to subsequent movement in any wounded or diseased joint.

If, in case of mere excision of a wounded semilunar cartilage, the patient should return, at the end of two months with a limp, is certain proof that there has been somewhere a miscarriage of surgery if not of common sense.

JOHN O'CONOR, *Buenos Aires, Argentina.*

BOOK REVIEWS

Orthopædic Surgery. By W. A. Cochrane, M.B., Ch.B., F.R.C.S.E., Assistant Surgeon, The Royal Infirmary, Edinburgh. New York, William Wood and Company. Edinburgh, E. and S. Livingstone, 1926.

This single volume has 528 pages and is well illustrated with 504 drawings and plates. The author considers that Orthopædic Surgery includes congenital and acquired deformities of the spine and extremities, infantile paralysis after the acute stage, the deformities of adult paralysis, torticollis, disabilities and diseases of bones and joints, including fractures and postural and static derangements. It is therefore to the above conditions that the author has confined his discussions.

The real function of the book is to point out that which can be done to improve structure and function. Hence, very little space is devoted to symptomology and pathology. It is essentially a book of treatment.

The contents are grouped in two parts. The first considers the relation of physique and correct posture to the art of medicine and the physical education in relation to medicine, and lastly, the physical reconstruction of chronic patients. The second part deals with the actual disabilities, diseases, affections and deformities of the various bones, joints and muscles themselves.

As a general aid to the practitioner as well as a source of concrete help to the orthopædist, the book is recommended.

Merrill N. Foote, M.D.

Plastic Surgery of the Head, Face and Neck, by H. Lyons Hunt, M.D., L.R.C.S. (Edin.). Cloth. October, pp. 404. Philadelphia, Lea and Febiger, 1926.

The reviewer must admit at the outset an admiration for what may be termed the British school of medical literature because of its clarity, simplicity and thoroughness with entire absence of cumbersome and pedantic phraseology.

The various chapters of this splendid monograph open with a description of the surgical anatomy of the part followed by an analysis of the condition and the principles requisite for its operative relief. The chapters conclude with the application of these methods to the cosmetic condition at hand. As a preliminary step he often makes a plaster model and pastes chamois over it for an experimental operation.

The texture, color, moisture, elasticity, and age of the skin must all be estimated. No ligatures are used, sutures are removed as early as possible and an ice bag is applied immediately following operation for "success in plastic surgery is largely dependent upon the elimination of hemorrhage."

His chapter on paraffin injection seems to prove conclusively that it is "an inexcusable practice." There are numerous case reports illustrating this.

S. R. Maxeiner writes the chapter on Local Anæsthesia in Operations upon the Head, Face and Neck. In the section on Grafts and Transplants there is a very interesting page on blood matching and grouping in relation to permanent takes of isografts.

The author believes that the exposure of wounds to fresh air and sunlight lessens infection by inhibiting bacterial growth and keeping the wound dry. He uses a slanting or oblique incision through the skin, except of the scalp, and emphasizes the importance of avoiding trauma, tension or hemorrhage. The " Prevention of Scar Formation by Rapid Fibrolysis " is very enjoyable reading, for it describes the author's experiments which finally led to the production of a powdered bile from Florida turtles to absorb the excessive fibroblasts without injuring the surrounding healthy tissue, thus materially preventing scar formation.

The chapter on Keloids is a valuable one. Various methods are considered in detail, including the author's favorite method of treatment. Congenital and Acquired Defects, Burns, Hare-lip and Cleft Palate and Fracture of Maxilla and Mandible are fully covered.

The final chapter by Sinclair Tousey is devoted to Physiotherapy in Superficial Surgery of the Face for Epilation, Cicatrices, Keloid, Telangiectases, Epithelioma, Warts, Moles, Keratoses, Acne, and Xanthoma. Electrolysis, Diathermy, Radium, X-ray, High Frequency, etc., are all considered.

The bibliography goes back to 1919. It is full and embraces French, German, and Austrian, as well as English sources. The illustration and anatomical charts are good. The author gives due credit to others for what they have done and written, but always describes the method that he has found best from his own extensive experience.

HENRY F. GRAHAM, M.D.

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All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS *of* SURGERY
227-231 So. 6th Street
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